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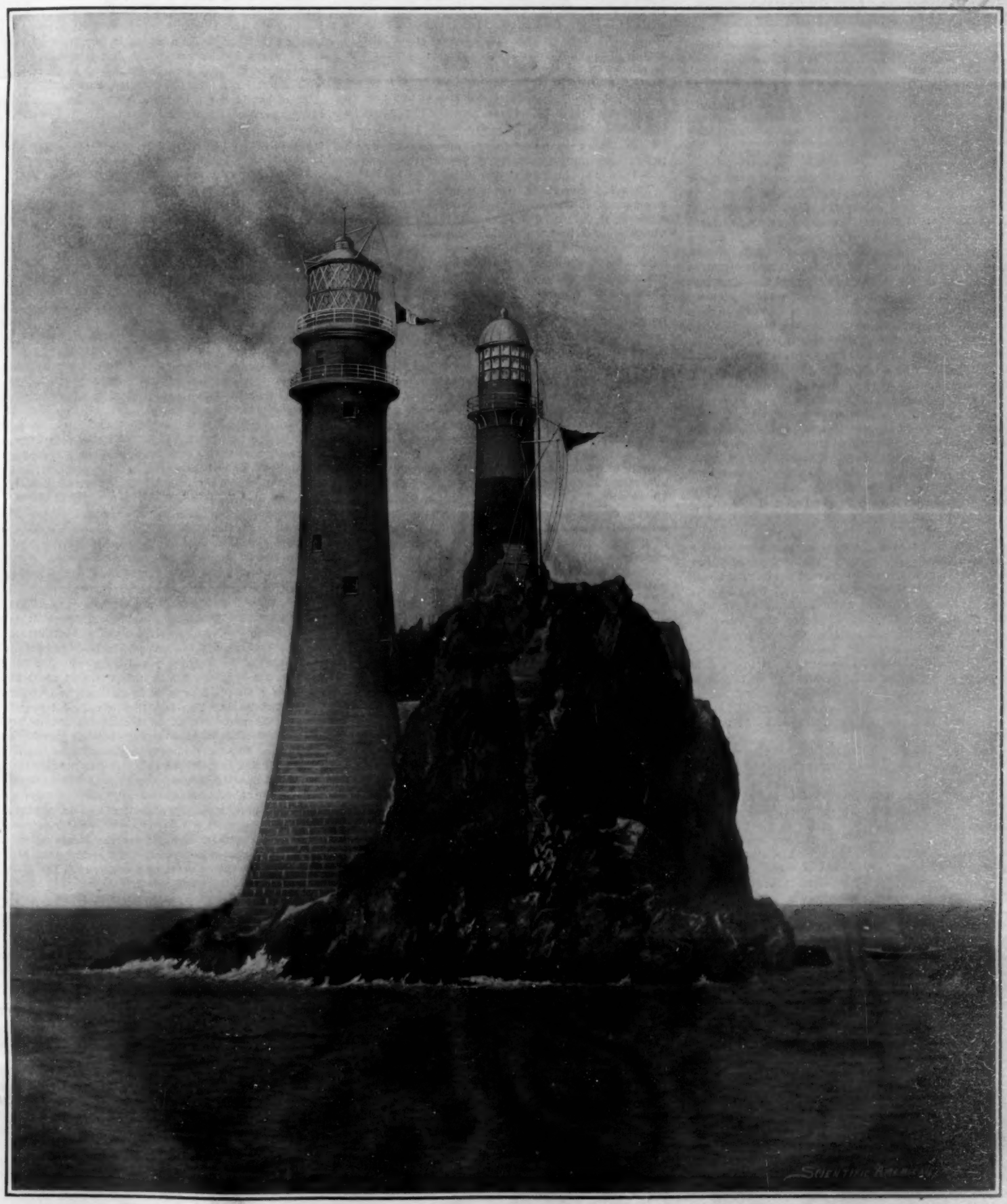

FASTNET ROCK LIGHTHOUSES AS SEEN FROM OCEAN LINERS.—[See page 226.]

Height of Focal Plane, 159 Feet Above High Water.

SCIENTIFIC AMERICAN

ESTABLISHED 1845

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NEW YORK, SATURDAY, SEPTEMBER 28, 1907.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

OUR ENORMOUS FIRE LOSSES.

We note that in a recent interview, the president of the New York Board of Fire Underwriters has made an alarming statement, to the effect that it is only a matter of time before the skyscraper district of New York may be destroyed by fire. We presume that in making this statement he had in mind the disastrous conflagrations in Baltimore and San Francisco; but we think that, as matters stand to-day, there is a wide difference between those two cities and the present condition in lower New York. In Baltimore, and even more so in San Francisco, there were a few scattered tall buildings of fireproof construction standing in the midst of a mass of old buildings of very inflammable construction; whereas, in lower New York, the greater part of the older office buildings are of semi-fireproof construction, erected some twenty-five or thirty years ago; while from the midst of these rise modern steel buildings built according to the most approved methods of modern fire protection. Should a fire assuming the proportions of a conflagration start in the lower part of lower New York, it would find no such mass of highly combustible material to feed upon as it swept toward the tall building district, and when it reached the latter, it would be brought up against a curtain generally some 300 feet in height, and frequently a block in depth, which would prevent the onward sweep of it until the Fire Department, massed from all over the city, had got it under control. Although we have no wish to decry the undoubted fire risks which do exist, we believe that to state, as the president of the Board of Fire Underwriters has done, that the whole skyscraper district would be wiped out, is to discredit the modern system of fire protection as such, just at the very time when the public is being brought to realize that the only rational system of construction is one that cannot be destroyed by that greatest of modern destructive agencies, fire.

Such fires as have occurred during the past few years in office buildings of thoroughly up-to-date construction (except, of course, in the cases of Baltimore and San Francisco) have been limited to the building, if not to the very floor on which the outbreak occurred. Residents in New York will recall to mind the case of the Home Life Building, a sixteen-story structure on Broadway, which was attacked at the ninth floor by the flames from one of the old style of construction buildings adjoining. The fire passed through the upper eight stories, burning the woodwork and furniture, but leaving the lower eight stories intact. The essential structural portion of the building was so little injured, that in two weeks' time repairs had been made and the whole building was ready for occupancy. The Home Life Building having been constructed several years ago, did not embody some of the very latest ideas in fireproof construction, such as metal window sashes and wired glass. Had it possessed these in addition to outside steel shutters, the building would have been absolutely secure against attack. Indeed, in commenting upon the alarming prophecy of the destruction of lower New York, Mr. Fitzpatrick, of the International Building Inspection Society of Washington, states that the skyscraper district of New York is about the safest place from fire in the entire country; and that if the owners of the buildings would but put wired glass in metal sash in the windows, where they have not already done so, that district would be so safe that little or no insurance would need to be carried upon those very buildings whose ultimate destruction is predicted.

At the same time, there is no denying that the fire departments are looking with much misgiving upon the present tendency to carry the tall building up to unprecedented heights. They point to the fact that in the case of a structure like the Singer tower, which is over 600 feet in height, the firemen would be able to reach only a few of the lower stories directly from the street. Of course, in the case of an outbreak, the security of such buildings is dependent upon the extent and quality of the fire-fighting apparatus installed as part of the equipment of the buildings themselves. It is imperative that the fire-fighting plant should be such as to permit of a very speedy attack, with an ample pressure of water, upon any floor of the building throughout its entire height; and provision should certainly be made for cutting off any floor upon which a fire may start from the stairways and the elevator shafts. In a building 600 feet in height, the upward draft through the elevator wells, supposing that there was direct communication from a burning floor to the shaft, would be of enormous strength; and the fierce rush of air would, of course, add greatly to the intensity of the heat. On the other hand, it would be quite possible, by means of sliding doors or other suitable means, to cut off a burning floor from the elevator well or other vertical opening. If in addition to this, the interior woodwork, sashes, doors, and trim were entirely replaced by metal work, the risk of fire, even in a building of the height of the Singer tower, might be considered to be absolutely eliminated.

IMPORTANT ADDITION TO NEW YORK CITY'S WATER SUPPLY.

When it was realized, in the summer of 1904, that emergency measures must be taken at once if New York city was to be rendered safe against the perils of a water famine, steps were quickly taken to provide additional reservoirs in the Croton watershed, to afford an additional amount of eighteen billion gallons beyond the storage capacity of the then recently completed Croton dam. The first of these new reservoirs has recently been completed, and its rapid erection is in gratifying contrast with the interminable delays which have seemed to be inseparable from large municipal undertakings of this kind.

The new reservoir dam has been built over the Cross River near Katonah, and it serves to impound the waters of this river and its tributaries. The plans of the structure were approved February 7, 1905, and the contract was awarded on June 20 of the same year, so that the whole work has been completed in about two years' time, and this in spite of the fact that because of an injunction brought by certain Tammany interests, the work was delayed for fully five months. We mention this fact because the contract was awarded to the contractors who have recently received the Ashokan Dam contract—a twelve million dollar job. If the firm exhibit the same celerity in the larger contract that they have in the smaller, there is every prospect that a portion at least of the new Catskill water supply will be available for city use by the year 1912.

The Cross River is impounded by a dam which is 900 feet in length, 170 feet in depth from crest to foundations, and contains about 160,000 cubic yards of masonry. The Aqueduct Board allowed twenty-six months for the completion of the dam; and hence it will be seen that, despite the injunction, the contractors have finished the work well within the contract time. The capstone of the dam was laid on August 7 by the Mayor of New York; who thus becomes still further identified with the improvement of New York city's water supply, a work with which his name will always be honorably associated in the annals of the city. The water at once began to accumulate in the reservoir back of the wall; but owing to the drouth, the rise of level was at first very slow, although the rather heavy rains of the present month are producing a more rapid rise. It is confidently believed that the construction of this and a reservoir of about the same capacity, each holding about nine billion gallons, will serve to tide the city over any possible dry season which may occur during the next five years—or until the waters of the new Catskill supply can be brought by the new aqueduct to Croton reservoir to augment the supply through the new Croton aqueduct.

OBSERVATIONS OF MARS DURING THE RECENT OPPOSITION.

For some unaccountable reason there seems to be a strong prejudice among both scientists and laymen against acknowledging the existence of a race of intelligent beings upon any planet other than our own. We cannot help thinking that our earth is the most favorably situated of the solar system, and is the best suited to support life. To be sure, this is so as regards life with which we are familiar; or to state it more correctly, the animal and vegetable life of this earth has adjusted itself, its habits, and its requirements, into harmony with conditions already fixed upon earth. This is no argument that life cannot adjust itself to conditions such as are found on other planets.

Those laymen who expected that the question of life on Mars would be settled by observations during this summer's favorable opposition, were predestined to disappointment. No one who is familiar with the subject expected as much. It is highly improbable that we can ever prove with mathematical accuracy that animal life does exist upon the planet. It is far easier to prove the existence of vegetable life by the seasonal changes in the color of large fields or forests. If these areas of vegetation show any unusual configuration and arrangement such as the "oases" and "canals" or "lanes of vegetation" on Mars, it is not unreasonable to argue that the vegetation is being cultivated or regulated by a race of intelligent beings. At the same time, the existence of such beings is not infallibly proved by such evidence. The best that Prof. Lowell expected to do this summer was to corroborate his previous discoveries, and make further observations along the same line. This he reports to have been successful in accomplishing. With the aid of photography he has established beyond doubt the existence of a delicate tracery of lines on the sphere. In addition to this, he finds that the southern hemisphere, which has heretofore been unfavorably situated for observation, is also crossed with a similar system of so-called canals.

There has been considerable criticism by prominent astronomers of the work done by Prof. Lowell as given out in his preliminary report. In reply to this criticism, Prof. Lowell states that he is a specialist in the study of Mars, and he is better fitted than others of his own profession to judge of the conditions on that planet. This idea of specializing in astronomy may appear to be somewhat new, although it is not at all unreasonable. No other branch of science presents so large a field of investigation, particularly in these days of the spectroscope, which instrument permits us to come into intimate contact not only with the members of our own solar system, but with the composition and daily motions of the immeasurably distant stars. Other sciences are divided into special branches with their acknowledged experts and specialists. It is only reasonable to so divide the work of the astronomer. It is not everyone who can see the canals of Mars, even through the best of telescopes. It requires a practiced eye, and one trained to this particular class of work. The telescope which Prof. Lowell uses at the Flagstaff Observatory is not of unusual size, and is not used to the limit of its power. It is impracticable to use a power of more than a few hundred diameters, because atmospheric disturbances are equally magnified, and to such an extent that the delicate lines on the planet are lost. This being the case, it appears that we have about reached the limit of the possibilities of the telescope, and what further discoveries are made on the planet will be due, not to more powerful lenses, but to keener eyesight and more experienced observation; in other words, to the work of a specialist.

CRACKED CAR AXLES.

The method of lighting railroad cars by electricity generated by a dynamo driven from one of the car axles is increasing in the United States. According to the Electrical Review, the positive danger of drilling holes in the axle when attaching the equipment has not been realized, though it is generally understood to be inadvisable. The fact that a drilled hole will prevent the spreading of an incipient crack is well known, and often taken advantage of; but it does not seem to be as widely known that sometimes a crack may be started by a drilled hole. In any material subject to alternating stresses cracks may appear where there is an abrupt change of sections; or where a notch has been made by a cutting tool in a turned surface.

In two recently fractured axles the break occurred through the center of shallow holes, which had been drilled to receive the point of a set screw. The diameter of the axle fractured was in each case 3¼ inches, and the breaks occurred after running 15,380 and 13,900 miles respectively. The cracks were several inches from the keyseats, and at points where the stress would not be maximum. As a result of these breaks, set screws have been superseded by a pair of clamped plates gripping the axle and bolted to one another.

Where axles have been drilled, however slightly, they should be carefully inspected from time to time, to discover any cracks as soon as they appear.

Some years ago a fleet of British colliers was sunk during a storm in an English harbor, and remained under water for five years before being salved and brought to the surface. An examination of the coal showed that it had kept its value for steam purposes, and this led to some experiments by the naval authorities, which settled beyond all doubt that coal stored under water did not deteriorate as when stored in the air. Taking heed of this conserving power of water, the Western Electric Company is building flooded coal pits at its plant at Hawthorne, Ill. The excavation is 220 by 75 feet and 12 feet deep, built of concrete, and divided into twelve pits. The coal is dropped directly from the cars, which pass over the pits, and the fuel is removed when desired by means of a steam shovel.

FABLED CITIES SUBMERGED.

BY ARTHUR H. J. KEANE.

Many of those persons who have been fortunate enough, due to ample means or lucky circumstances of a business or other nature, to spend a holiday at many of the charming resorts dotting the coast line of the German Ocean, will have been amused (and perchance interested) by the many tales and legends related as to submerged cities—all supramundane trace of which has now disappeared. Of such cities which once were famous for their wealth, beauty, and power, it is whispered that their love of luxury, their greed, and cruelty led to the offended and unseen Powers Above causing the waves to rise in the night and engulf them for ever. Not only are such legends rife on the coast, but even in inland German towns many a lake is invested with a halo of similar mystery.

Of these latter cases, two of the most interesting relate to an old-time city named Buckow, which is said to rest upon the bottom of Lake Schermützel in Brandenburg, while Lake Werbellin (a most mysterious sheet of water, according to folk-lore) conceals in its bosom a town of the same name; all that remains of this latter is the name given to a small village, in memory of its predecessor, which now stands not far from the point where the former town stood.

Although most of the stories rife in Germany as to vanished towns in the interior have no actual historical basis, or at best a slight one (the Werbellin story being based upon the disappearance of a castle called Werbellin, one of the Ascanian castles built in 1150-1170 by Albert the Bear, Margrave of Brandenburg, and a contemporary of Frederick Barbarossa), this is not so on the coast; here the legends are all well founded on fact, and, in most cases, the salient features have lost but little of their original truth in the telling.

The most striking of all the legends current in the coast towns of the German Ocean is that dealing with the lost Dutch town of Stavoren at the entrance to the Zuyder Zee. Here there lived a rich and powerful lady, whose pride, cruelty, and selfishness aroused the anger of Heaven, and caused the wicked and misguided city to sink beneath the waves. A small portion of the city (where the good people lived) was saved, and its name still cleaves to the small town of Stavoren, which is well known to every traveler going by water from Amsterdam to Leeuwarden and Groningen. It is an undisputable fact that, in the thirteenth century, Stavoren was a wealthy and powerful commercial city; however, due partly to the port becoming choked with sand, and partly to the irruption of the Zuyder Zee in 1277, it rapidly lost its importance, and at the present time what is left of it only affords shelter to about eight hundred souls. The roofs and spires of the now submarine buildings can, it is said, be often seen far down in the depths when the sea is still and the weather is clear, while silent listeners on Christmas Eve will hear the distant and muffled tone of church bells arising from the depths, only to break in bubbles and ripples on the surface of the Zuyder Zee.

Visitors to Sylt, the well-known seaside resort and island in the North Sea, will doubtless remember the small village of Wenningstedt. Although its present population is only fifty persons, it is none the less commemorative of the large commercial town of Wenningstedt, which went to the bottom of the sea during a great flood and storm which took place on the 16th of January, 1362.

Wenningstedt is by no means the only town which once stood on the shores of Friesland and Holland, only to meet with destruction at the hands (or rather billows) of "Old Hans," as the Frisian familiarly terms the North Sea. As a matter of fact, of all the seas in the world, it is the German Ocean alone which can establish a record for the number of towns, villages, and hamlets which it has either destroyed or engulfed. Since the eleventh century "Old Hans" has devastated no less than one hundred and forty-four towns and villages, either by swallowing them up entirely or else by burying them under heaps of sand. The fate of the Dutch town of Rungholt, which disappeared during a great storm in the year 1337, is still sung and told in story by the present day fisherfolk of Holland.

The Baltic Sea has not such a bad record in catastrophes as "Old Hans." Yet a halo of romance is thrown around the legends told about this sea, by the story of the wonderful town of Vineta, chimes from whose church steeples may, at the fall of eventide, be heard pealing faintly from the depths of the ocean. In the seventies of the last century articles were still published in support of the sometime existence of a large, fabulously wealthy Wendish city named Vineta, which, in the middle ages, nestled at the foot of the Stakelberg at Usedom, nearly at the same altitude at which the hamlet of Damerow now stands The legend states that it was totally destroyed by a flood and earthquake which occurred in the year 1183 At one time the city of Vineta was marked on the Prussian maps, but geological and historical investigations made locally by Prof. Virchow and others have proved beyond doubt that a town never could have stood upon the site indicated. Researches into the origin of the legend led to the remarkable discovery that the name of Vineta was nothing more than a corruption of Jumneta and Jumne—the old Wendish name of the modern town of Wollin, or Julin as it was called by the Danes. The reported fabulous wealth owned by Vineta was to a certain extent true, as Julin or Jumne was—according to the old historian Adam of Bremen—a very large and remarkably wealthy town in the tenth century, doing even then a trade with Arabia, Asia, and the coast towns of northern Africa. To use the historian's own words, this old Wendish town was "certainly the greatest of all the towns now existing in Europe."' When the Danish King Waldemar the Great crushed out the power wielded by the Wends, he also destroyed Jumne by burning it to the ground in 1172; hence in this case the earthquake and flood business is a mere fabrication. The Baltic Sea can boast of no sunken cities, although it has caused considerable destruction to life and property by floods. A few of the more important instances are: (1) The great flood of November 1, 1304, which submerged the whole of the strip of land which connected the present island of Ruden with Rügen; (2) the flood of November 13, 1872, which rent the islands of Usedom and Hiddensee into two parts; while (3) the flood which took place on April 13, 1903, destroyed the well-known and beautiful Adlerhorst resort on Arkona.

But to turn to other parts of the world. Here there are not many known instances of sunken cities; still there are a few. The latest known case is that of Galveston, which, as will be remembered, was destroyed and partly engulfed on September 8, 1901.

Modern engineering science has now, however, done much to protect us from the vagaries of "Old Hans" and others of that ilk, so that coast towns often smile now at the thought of any danger. Yet in view of the San Francisco catastrophe, are they safe? Unexpected earthquakes ere this have worked terrible havoc in Europe. On August 24, 358, the Black Sea was lashed into fury by a terrible earthquake and did fearful damage. Again on July 21, 365, Europe was visited by the most terrible earthquake ever known; all the coasts of the eastern Mediterranean with its adjacent seas rose in their might (due to seismic influences) and destroyed many towns, while several islands in the Aegean Sea disappeared forever with all their population. As later examples of what the sea can do, when disturbed by earthquake shocks, we may mention the destruction of Lisbon on November 1, 1755, and the utter annihilation of the towns of Anjer, Merak, and several other villages and hamlets in Java and Sumatra by the great tidal wave which accompanied the eruption of Krakatoa on August 27, 1883.

Many towns have also disappeared, due to land slides, avalanches, etc., which have hurled them into lakes, and inland seas. Local legends say that huge devil-fish live in these lakes, and it is their movements which cause the towns to slip down and hurl their contents into the depths, where the monster can then glut his maw on mangled flesh and blood. Of course most of these reports are mere tales, but there are two recorded cases of inland towns being engulfed beneath the waters of adjacent lakes. The first of these is afforded by the disaster to the town of Zug, Switzerland (population 4,400) which was swallowed up in the lake of the same name on July 5, 1887.

To conclude, we will mention the disaster which befell the small hamlet of Tiefengruben about thirty years ago. This was a pretty little village, situated near Kranichfeld in Thuringia, Germany; in the center there was a small innocent-looking pond, upon which the good people used to keep their ducks and other water-loving fowl. One stormy day, why and wherefore Heaven only knows, the village went down, and its place was taken by a large lake, which still marks the site of the ill-fated village. The benighted peasant returning home after a hard day's work felling timber in the forest surrounding Kranichfeld, often sees uncanny-looking lights flitting about over the marshy ground, and mutters a prayer for the rest of the troubled spirits who—he thinks—are hunting for their lost home. Friends of the writer have often seen these lights, which owe their origin to decaying vegetation. In fact, they are merely ignited marsh gases or, as they are popularly termed, "will o' the wisps."

Advices of recent date contain some very interesting data as to what, it may be said, is nothing more nor less than a submerged city in the making. About six months ago, following upon a sudden and unexpected shock, a considerable portion of the pretty little town of Tavernola fell into Lake Isco (formed by the waters of the Oglio, between Brescia and Bergamo) upon the shores of which it stands. In the night of the 15th of November a further shock ensued, and a whole square and several of the remaining streets of Tavernola slid into the lake. The wretched inhabitants had hardly time to flee to the mountain at the foot of which the town nestles, or rather nestled. The government is now busy inquiring into the causes of the extraordinary phenomenon. Doubtless in time to come the ruined houses visible beneath the waters of the lake will form the object of legends similar to those enumerated in the foregoing article.

SCIENCE NOTES.

Dr. Hugo Miehe, who has studied the spontaneous heating of newly-made hay ricks, considers the heating as entirely the result of physiological action and not, as is generally supposed, due to the action of bacteria. Several thermophilous species of bacteria and fungi, some of them new, have been obtained from heated hay. Dr. Miehe thinks that injurious kinds of bacteria and fungi are probably fostered by sweating manure, and that the common occurrence of the tubercle bacillus may be due to this cause.

The name of Luther Burbank has long been known as that of the wizard of botany. At a recent lecture at Stanford University, seventy-three different species of apples were shown, all gathered from a single tree in Mr. Burbank's garden. While fond of the botanical pranks which appeal to the public mind, Mr. Burbank fortunately does not neglect the more serious part of his profession, and devotes much time and thought to the cultivation of improved plants likely to be of economic value.

A fish which feeds on mosquito larvæ is reported from Australia. This fish, known to science as *pseudomugil signifer*, and popularly known as "blue-eye," owing to the brilliant blue color of its iris, belongs to the family of *athorinides*, a small carnivorous fish found in both ocean and rivers. The blue-eye is a very small fish, about two inches long, and is generally found in shallow water. It is said that the Italian government is much interested in this matter and is importing a number of the fish to test their efficiency as larva destroyers in swamps and marshes.

Archæological interest is at present centered on Pæstum in Italy, where three very beautiful Greek temples stand. Owing to unhealthy malarial conditions, little exploring work has in the past been done on this site, but recent excavations have shown that the temples were merely part of a city. Prof. Spinazzola, who is superintending the operations, has uncovered, a few yards beneath the surface, a perfect street, thirty feet wide, well paved but showing the ruts of heavy traffic. Great numbers of objects of iron, bronze or stone have been unearthed and it is proposed to turn an ancient Greek tower on the banks of the river Salto, near the site of the buried city, into a museum.

In spite of the appliances of modern science and invention, Arctic exploration remains a pursuit attended with great risk and hardship. It is feared that William Bruce, a Scotch explorer, has been lost, together with two experienced companions. Mr. Bruce left his base of supplies in Spitzbergen early in August, accompanied by Capts. Johansen and Bracsen, and a search party has found traces of one of their camps, and their sleds. It is thought they were lost in attempting to cross Prince Charles Bay, Spitzbergen. Bruce went with the Antarctic expedition which left Dundee in 1892, with the Jackson-Harmsworth polar expedition, and the Prince of Monaco's expedition to Spitzbergen. He was also a member of the Scotia Antarctic expedition of 1902. Capt. Bracsen accompanied the Prince of Monaco in his expedition to Spitzbergen, and Capt. Johansen was a companion of Dr. Nansen in the latter's Arctic explorations.

In a recent paper Dr. J. W. Spencer has given some interesting data in respect of the "Age of the Niagara Falls." Soundings at all the points of great changes in the Gorge have been successfully undertaken, borings were put down for the exploration of buried valleys, and instrumental surveys made of the original river banks and the physics of the stream. The mean recession of the crest line of the Falls is found to be 4.2 feet a year under existing conditions, and this rate has approximately obtained for 227 years. But this rate will not give the age of the Falls, on account of other great variations in the volume of the river and the height of the Falls themselves. The chief change in volume of water depends on the fact that originally Lake Erie alone was discharged over the Falls when the supply of water was only one-fifteenth of the present discharge. Above Foster's Flat the sudden widening indicates the inflow of the other lakes into Erie, greater water discharge, and greatly increased rapidity of recession. The Whirlpool is on the site where the recession broke down the partition separating the head of the Whirlpool-St. David's buried gorge, and began to empty out the contents of this valley. The cutting with the full power of the water of the four lakes varies at times according to the height of the fall, and is calculated to have occupied 3,500 years. The entire age of the Falls is given as 39,000 years.—Knowledge and Scientific News.

A SIMPLE PIPE-BENDING MACHINE.

The pipe-bending machine shown in the accompanying illustration has many new and valuable features. It is strongly constructed and will stand great stress when bending the heaviest pipes. The gears, which are cut and of heavy pitch, have a ratio of 25 to 1, giving it a powerful leverage. Hence a boy can bend a 2-inch pipe with little effort.

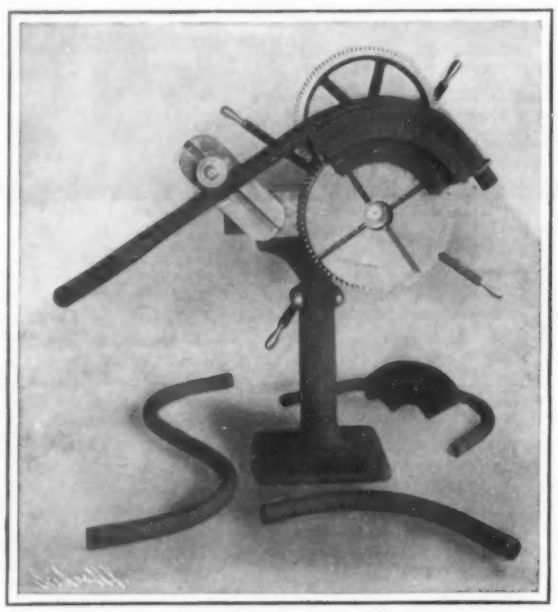
The continuous rotary movement of the faceplate upon which the quadrants or formers are placed is a distinct and desirable advantage and for many kinds of work it is obviously of much importance and convenience. The resistance stud is located on a movable arm provided with a "T" slot, permitting the stud to be placed anywhere within the radius of the arm. This arrangement provides the means for any kind of pipe bending.

The faceplate has four "T" slots upon which any style or shape former or quadrant can be attached. It will in consequence bend an infinite number of shapes without leaving any mark or disfigurement on the work operated upon. The machine is designed to be easily portable and has a telescopic stand which can be raised or lowered to a suitable height. When the base is fastened the upper part swivels. Plain or adjustable stands can be used as the requirements of the case necessitate.

Piping of steel, iron, brass, copper, or other material can be bent cold up to 2 inches in diameter. The machine is also adaptable by means of special formers for bending light angles, flat or tee bars. When pipes are coated by the Sabin process, galvanized, tinned, etc., this machine will bend such pipes to any desired shape without breaking the coating in any way.

The quadrants furnished with this machine are adapted for use on inch pipe with a radius of 6 inches; 1¼-inch pipe with a radius of 9 inches; 1½-inch pipe with a radius of 12 inches, and 2-inch pipe with a radius of 14 inches. While these four sizes are furnished with the machine, the fact that the smaller sizes of pipe can be bent in the larger quadrants makes it unnecessary to change the latter unless a shorter radius is desired than the larger quadrant will give.

The gears, the body of the machine, and the stand have been carefully proportioned to sustain the stress of the heaviest work. The weight of the machine complete is 750 pounds, and it is a very desirable adjunct in any plant where there is much pipe or conduit work.



A SIMPLE AND POWERFUL PIPE-BENDING MACHINE.

SIMONIS LIQUID-AIR APPARATUS.

BY THE ENGLISH CORRESPONDENT OF SCIENTIFIC AMERICAN.

The possibilities of the application of liquid air to rescue apparatus for operation in coal mines, sewers, fires, and other inclosed spaces in which noxious and asphyxiating fumes prevail, is at the present moment arousing deep interest in Great Britain. This apparatus, which is the invention of Mr. Otto Simonis, of Norfolk House, Strand, London, has been evolved from the experimental to the practical stage, and is now being severely tested both by the Metropolitan Fire Brigade and the Royal Commission on Mines. The utilization of liquid air for rescue purposes has for some time past been attempted, but experimenters have found considerable difficulty in the handling of liquid air, as well as the control of its reversion to the gaseous state, in a manner coincident with the pressure requirements for human inhalation, without any resultant waste. These problems, however, have been satisfactorily and successfully overcome in the Simonis invention, which is known as the "Aerolith" apparatus, and the numerous experiments and practical application of the system that have been carried out in Lord Rothschild's Austrian coal mines have demonstrated its efficiency and value. Mr. Otto Simonis, who has for many years been associated with the evolution of fire-fighting and rescue apparatus, has been engaged for some time past in the application of liquid air for the latter purposes, having abandoned the oxygen system, with which he was originally identified.

The "Aerolith" apparatus, which we are enabled to describe and illustrate through the courtesy of the inventor, presents many ingenious and striking features, the most notable being the entire absence of valves of any description, as well as the novel means adopted for absorbing the liquid air, the discovery of the inventor, whereby this material can be brought under complete control by an easy expedient, constituting a most prominent feature. The apparatus is of a very simple character, and is comprised of a bag containing the liquid-air absorbing medium, which is strapped to the wearer's back like a knapsack, so that the arms are left entirely free. The apparatus is not unduly heavy, weighing only twenty-four pounds when fully charged. From the top of the knapsack extends a flexible tube connecting an upper section of the chamber containing the absorbed liquid air with the mouth, there being a mask fitted over the entire face with mica glazed apertures for the eyes, or simply a mask inclosing the eyes and mouth. This flexible coupling, which is about one inch in diameter, is connected by another short length of flexible tube of smaller diameter, the connection being made about six inches below the mouth to the liquid air container at the opposite upper section, as shown in the illustration.

FRONT AND REAR VIEW OF WEARER OF A SIMONIS LIQUID-AIR APPARATUS.

The most essential part of the apparatus is the compartment containing the liquid air. This is filled with asbestos wool, which the inventor has discovered to be the very best of all absorbing substances, while at the same time it enables evaporation to be automatically controlled. This absorbent is thoroughly regulated by special means, so that not only is evaporation avoided when the apparatus is not in operation from external heat, but at the same time when evaporation is in progress, to affect it so gradually as to be just sufficient for the needs of the wearer's lungs. Attached to the apparatus and lying flat against its outer surface is a second bag, through which escapes exhaled air from the lungs.

The operation of the apparatus is extremely simple. The wearer clamps the mask carrying the mouthpiece from the liquid air chamber to his mouth, and commences to breathe in a normal manner. The warm expired air from the lungs passes through the tube, and enters the chamber containing the absorbed charge of liquid air. The temperature of the volume at once causes the evaporation of a small quantity of liquefied air of the same volume as would be exhaled by a man under ordinary circumstances. This evaporated charge passes up the second tube, and by the next inhalation is drawn into the wearer's lungs. This cycle of operations is repeated, the warm expired breath evaporating charges of fresh air until the supply has become exhausted. The atmosphere evaporated from the absorbing material is cool, fresh, and pure, the intense cold of the vaporized air being warmed by its passing through the tube, so that by the time it reaches the mouth, it can be inhaled without the slightest discomfort. The expired air, after passing over the absorbing medium and releasing the requisite quantity of fresh air in its passage, finally escapes into the outer atmosphere.

The liquid-air absorbent reservoir is charged from a supply carried in a small receptacle, the liquid air being stored in a spherical vacuum vessel of the type evolved by Prof. Dewar. This reservoir is well insulated, the loss from evaporation being very small. It is made of varying capacities according to requirements, the average capacity ranging from 0.7926 to 1.5852 gallons. As air in its liquefied state is compressed into one eight-hundredth part of its own volume, 1.32 gallons of liquid air evaporate into about 244,080 cubic inches of pure air at atmospheric pressure; this quantity is sufficient for about three hours' use.

In connection with the evolution of the "Aerolith" apparatus, the inventor has also devised a cheaper method of producing liquefied air than those in use at present. With the apparatus he has designed, the cost of production is approximately eighteen cents per gallon, but by the aid of some recent modifications in the plant, it is anticipated that the cost will be reduced to five cents per gallon. In the case of large coal-mining areas, such as those existing in the north of England, Westphalia, and Pennsylvania, it would be more economical to erect one central generating station to serve a large number of mines. A plant occupying a total space of not more than 45 square feet, with an 8-horse-power engine and capable of producing one gallon of liquid air per hour, can be erected for about $2,000. One of the greatest objections to the general use of liquid air is the difficulty experienced in transporting it on account of leakage, but when stored in reservoirs of the insulated vacuum type, as constructed by Prof. Dewar, the loss by evaporation is reduced to a minimum.

The advantage of the Simonis invention is that it is compact, and being void of controlling valves there is no mechanism which is liable to become deranged. As it is comparatively small in size, it can easily be strapped to the back without inconveniencing the wearer, and therefore is peculiarly well adapted for work in dangerous mines. The possibility of the supply becoming exhausted is well provided against, as the rescuer carries a small alarm clock in his pocket, which gives at least twenty minutes' warning before the supply becomes exhausted.

The London Metropolitan Fire Brigade is giving the apparatus a severe and practical trial, and it has already been adopted exclusively in the Rothschild mines in Austria, where after several months' use it demonstrated its great efficiency and reliability.

Electric Operation of Spanish Standard-Gage Railways.

According to the Continental technical press electric operation on standard-gage railways is now to be introduced into Spain, where on a section 22 kilometers (13.6 miles) in length of the Linares-Almeria line an experimental service is to be started. This section, from Santa Fé to Gergal, shows a practically constant gradient of about 2.75 per cent.

According to the scheme adopted, electric locomotives are to haul trains 150 to 300 tons in weight at a constant speed of 25 kilometers (15½ miles) per hour, thus allowing a train to be dispatched each hour, while trains at present cannot follow up each other at intervals of less than two hours.

A special steam-driven power station is to be erected at Santa Fé. Later, if expectations are realized, the water power available in the neighborhood will be used for electrifying other parts or the whole of this line. Rotary current operation has been chosen, as on one hand a considerable saving is obtained by recovering energy on the down-hill journey, while experience on the other hand goes to prove the simplicity and reliability of this system, especially for heavy traction purposes.

Five locomotives are to be supplied by a Swiss electric company, which also constructs the whole of the electric equipment. The double-pole overhead trolley line will be worked at a tension of 5,500 volts. The locomotives are of the double-axle type and are designed for an output of 320 horse-power each. The course generally adopted will be to couple two such locomotives to the head of the train, while for yard purposes these locomotives will be used singly.

The Cunard steamship "Mauretania"—sister ship to the "Lusitania"—has just undergone successful speed trials off the east coast of England.

WIRELESS TELEPHONY FOR THE UNITED STATES NAVY.

BY HERBERT T. WADE.

A most essential condition of modern warfare is to maintain unbroken and complete communication along the entire line, from the commander-in-chief and the board of strategy to "the man behind the gun." Every device in the way of a signal or telegraph that accomplishes this purpose must be employed, and new inventions are warmly welcomed, especially in the naval service, where to secure the best results a fleet must move at the direction of one man, and often as a single unit. Accordingly, when it was announced recently that wireless telephony had been developed to a practical state, it was but natural that the United States navy should wish early to test its claims, with a view to its extensive adoption for intership communication, as well as for talking between sea and shore or between temporary or isolated stations, as on islands. For such tests apparatus has recently been installed on the U. S. battleships "Connecticut" and "Virginia" by the Radio Telephone Company under the direction of Dr. Lee De Forest, who for several years has been devoting himself to the transmission of articulate sounds by electrical waves, and has developed his apparatus so that the practicability of wireless telephony on a commercial scale seems assured. If the report of the naval officers supervising these tests is satisfactory, it is quite probable that the new Pacific fleet, at least, will be completely equipped with apparatus for wireless telephony.

The Audion.

The Radio-Telephone Transmitter.

The present application and tests involve the installation of transmitting and receiving apparatus in the wheel house or on the bridge of the battleships, working in connection with, yet quite independent of the ship's ordinary wireless telegraph equipment. This enables the admiral or captain to converse with any ship within five miles, the contract limits of the present installation. The apparatus as now constructed is the result of an exhaustive series of laboratory experiments by Dr. De Forest, combined with practical tests made last July on Lake Erie, when wireless telephony was used in reporting a yacht race to communicate between a small yacht in motion and the shore. On this occasion it was shown publicly that for distances up to four miles, satisfactory telephonic communication without wires is perfectly feasible, and it is with an improved form of this apparatus that tests are being made by the navy. Just previous to shipment to Provincetown for installation on the battleships, and while undergoing the final laboratory testing, the instruments were specially photographed for the SCIENTIFIC AMERICAN, and are shown in the accompanying illustrations.

In explaining the construction and operation of the De Forest system, it may be desirable to say a few words as to the underlying theory. Wireless telephony, as also wireless telegraphy, depends upon the production of electric waves that pass through the atmosphere, and also solid substances, with a velocity equaling that of light—186,000 miles per second.

In order to transmit either telegraphic signals or vibrations corresponding to those of the voice, it is necessary to interrupt or vary these waves at intervals depending on the signals or character of the sound. The production and transmission of the waves is essentially the same in wireless telephony as in wireless telegraphy, but their interruption is an entirely different matter. The vibrations corresponding to the human voice have an average rate of about 500 per second, for a man's voice, extending up to 20,000 per second for the overtones, while in wireless telegraphy, manually operated, it is possible to work at a rate of about five interruptions per second, the telegraph signals of course corresponding to the familiar Morse alphabet. In wireless telegraphy the receiving of the waves is accomplished by any one of a number of devices, such as the coherer, the magnetic detector, electrolytic responder, etc., but in wireless telephony there is need of a specially sensitive device, and this is realized in the Audion, which, devised by Dr. De Forest and adapted for both space telegraphy and telephony, has been found a specially valuable element in the latter. This instrument, shown in the illustration, appears at first glance to be simply a small incandescent lamp, but there will be noticed a plate and a grid of platinum sealed into the bulb and connected with the exterior by platinum wires. The filament is of tantalum or other metal and is made to glow by a current from a small storage battery shown in the illustration on page 222. The action will be explained below more fully in connection with the rest of the apparatus whose connections and arrangement are indicated on the accompanying diagrams. At the transmitting instrument current is supplied at 220 volts from the ship's lighting mains or other supply such as a small dynamo driven by an oil engine or a dynamotor using current at a different voltage. This direct current flows through choke coils which prevent the high-frequency alternating current from passing, and then goes to the oscillator, which consists of an arc maintained in the flame of a small alcohol lamp. The production of high-frequency alternations from an arc was first discovered by Duddell in England and has been investigated by several physicists and experimenters, so that it was comparatively easy for Dr. De Forest to adapt the principle to his transmitting apparatus, although the actual application and the construction of a practical device required most elaborate and careful experiment. These currents with a frequency of about 40,000 per second pass through the primary of the transformer as indicated, a condenser being interposed in the circuit. The secondary of the transformer is connected with the antenna or aerial wire of the usual type used in wireless telegraphy, and to the ground through the microphone of an ordinary telephone transmitter. By adjusting properly the two circuits it is possible to produce in the aerial wire oscillations that will cause waves of the desired frequency to be sent out into the air. Now the vibrations of the voice acting on the microphone cause the resistance of the carbon granules to vary, consequently the resistance of the aerial wire circuit varies, and this correspondingly affects the amplitude or intensity of the waves emitted from the antenna, not cutting them off absolutely as in wireless telegraphy. Examining now the diagram for the receiving instrument, a similar aerial wire will be seen connected to the earth through one coil of a transformer, while the circuit of the secondary includes two condensers, the audion with its storage battery, and the telephone with its cells. The electric waves impinging on the aerial wire set up a series of oscillations, which in turn are reproduced in the corresponding circuit of the transformer and affect the audion, causing the resistance of the gas ionized by the heat of the glowing filament to vary in proportion to the amplitude of the oscillations in the aerial wire, and the diaphragm of an ordinary telephone receiver is made to vibrate in the usual manner, reproducing the sound spoken into the transmitter.

The conditions outlined above and explained by the diagrams are realized in the instruments themselves, shown in the illustrations. Here everything is brought together and the adjustments reduced to a minimum, so that by observing a few simple rules there is no need for a trained operator. The illustration shows the complete apparatus for a single station, with the appropriate connections and all adjuncts except the batteries and aerial wires. It will be noticed that the apparatus is simple and compact, occupying little more space than the familiar wall set of the ordinary telephone. The transmitting instrument on the left will be recognized from the familiar microphone transmitter, while the instrument is shown again by itself somewhat enlarged. The conductor leading to the aerial wire passes out at the top of the case and the source of current is connected with binding posts at the rear. At the side of the box is the oscillator or arc inclosed in its nickeled casing with the alcohol lamp beneath. This lamp is lighted and the transformer coils contained in the case are adjusted so that oscillations of the proper frequency are produced and waves of the desired length are emitted from the aerial wire. The action of the arc is indicated by the small incandescent "pilot" lamp shown at the top of the box, which is acted on inductively by the current in the primary of the transformer and glows when the oscillation takes place. The tuning of the transmitting circuit is accomplished with the small handle moving in the slot at the side of the box, while a listening key is provided to enable the operator to connect at will the aerial wire to either transmitting or receiving instrument. There is also a telegraph key and a device resembling the ordinary buzzer which is termed a "chopper" by Dr. De Forest, shown in the foreground of the illustration, which by simply cutting out the microphone with a switch in front of its case, enables the apparatus to be used for wireless telegraphy, sending the ordinary Morse signals. In telephoning, the method is to send a few such signals to attract attention and then to switch onto the microphone or talking circuit. The receiving instrument is contained in the two boxes shown at the right of the illustration. On the upper box is the two "pan-cake" syntonizer or

Complete Equipment of Transmitting and Receiving Instruments for One Station.

THE DE FOREST RADIO-TELEPHONE APPARATUS.

tuning device consisting of two coils where the number of turns can be varied at will, and beneath an adjustable condenser and impedance coils, the whole being tuned of course to the sending apparatus.

The lower box, from which leads pass to the telephone receiver, contains the audion, already described and illustrated, which is provided in duplicate in case of possible mishap, together with suitable switches and resistances to enable the current from the storage battery for the lamp circuit and that from the dry cells for the telephone circuit to be regulated and used most effectively. The speaker has merely to put the telephone to his ear, using the listening key, and to talk into the transmitter. The simplicity of the apparatus commends it for naval use, as it enables communication to be maintained not only between the vessels of a fleet but with torpedo boats or dispatch boats on detached service in maneuvers or in action. Furthermore, there is a field for use in communicating with colliers and supply boats, not to mention lightships, lighthouses and shore stations generally. With the improvement and increase in the range of action which is bound to follow now that a practical success has been assured, the usefulness of wireless telephony at sea will be widely extended. As a fog signal and means of communication in thick weather, it promises to increase the safety of ocean travel. Wireless telephony has also important applications on land which are attracting the attention of the inventor, but the apparatus above described is of special interest as being the first to be installed on U. S. naval vessels.

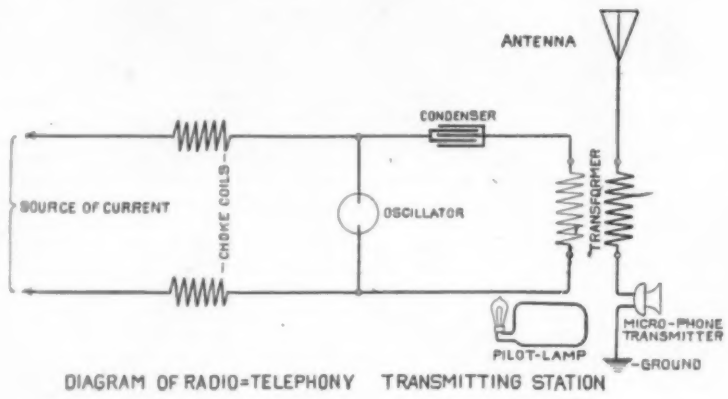


DIAGRAM OF RADIO-TELEPHONY TRANSMITTING STATION

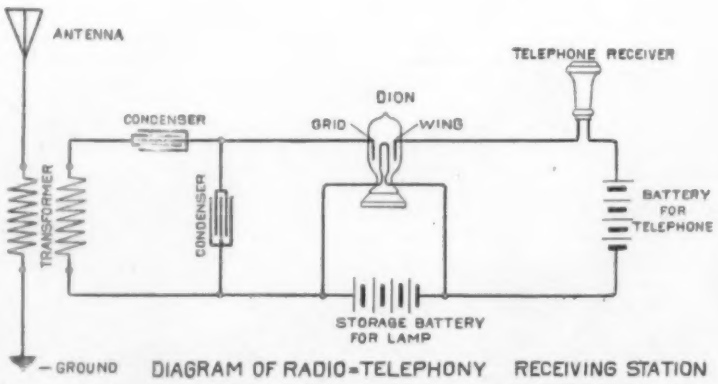


DIAGRAM OF RADIO-TELEPHONY RECEIVING STATION

WIRELESS TELEPHONY FOR THE UNITED STATES NAVY.

Stone Railways.

BY W. B. PALEY.

The real origin of railways is to be found, it has always seemed to the writer, in parallel tracks of stone laid down for wheel traffic, as distinguished from horse traffic, which could go anywhere. The nations of antiquity had, in many cases, got so far as this in the direction of railway making. How much further they would have got, had they not been swamped by the rising tide of barbarism, it is useless now to inquire. It is certain that there are plenty of examples of stone railways of great antiquity in Greece, Sicily, and the south of Italy. In 1842 a Mr. William Mure published in London "The Journal of a Tour in Greece and the Ionian Islands," undertaken four years previously. He seems to have been much struck by the many evidences that stone tracks were well known in that country in ancient times, and speaks of "the frequent occurrences of wheel ruts in every part, often in the remotest and least frequented mountain passes." These, he says, "are not to be understood in the sense of a hole or inequality worn by long use and neglect in a level road, but of a groove or channel, purposely scooped out at distances adapted to the ordinary span of a carriage, for the purpose of directing and steadying the course of the wheels. Some of these tracts of stone railway—for such they may in fact be called—are in a good state of preservation, chiefly where executed in strata of solid rock." Mr. Mure further argues that "the extensive use of chariots in ancient Greece, so conclusively proved by poetical tradition, could hardly have been possible without the aid of such roads." The famous ancient road through the Vale of Tempé, in Greece, is frequently seen ten, fifteen, and twenty feet above the present modern road. The ancient one is mostly in the solid rock, the worn sections being about twelve inches wide. This was a military road, but also over it were taken the blocks of marble from the Verde Antico quarries at Casamhola, which were rediscovered some years ago and are now in full work. Near them is a raised road through the marsh, made about the time of Justinian (A. D. 483-565), which also has grooves in it. Here the grooves are due to wear of the longitudinal blocks, in the other case probably surfaces were dressed for the wheels on the rockbed itself, as may be seen, for example, on the Acropolis at Athens, where similar faces remain, with a transverse notching between to give foothold to the horses. A friend of the present writer, well acquainted with Greece, considers that the Greeks never made such good roads as the Romans, and that the best of the ancient roads in that country were probably laid by the Romans themselves during their domination in the early part of the Christian era.

There seems no reason to suppose the Romans used long slabs of stone in parallel rows on any of the hundreds of miles of road they built in Britain. The amount of wheeled traffic was probably far too small to justify the time and trouble getting, bringing, and placing them would have involved. In the medieval period, too, there was next to no wheeled traffic, in fact the roads were not good enough for it. But about the middle of the eighteenth century the improvement of internal communication began to be taken up in earnest; turnpike roads, canals, and tramroads were made in all directions, and in about fifty years the country passed from being one of the worst to the best provided in Europe. Many of the canal acts authorized the construction of "tramroads or stone roads," the former meaning railways with cast-iron plates having an inner flange to keep the wheels in place, the latter trackways formed of dressed-stone blocks placed end to end. These were laid in several important instances in the years immediately preceding the introduction of steam railways. The making of the great road from London to Holyhead by Thomas Telford was perhaps the largest public work undertaken till then. In several cases where an easier gradient than 1 in 20 could not be had without great cost, a stone track was laid, at less than half the cost, while the tractive force required on the latter, for the same weight, was not half what was needed on the unpaved portion. In fact, so successful were stone trams deemed, that when steam road traction began to show its powers, it was seriously discussed whether an extension of this system might not advantageously be laid down, at any rate between London and Birmingham.

A very fine stone railway or tram was laid along the Commercial Road, in the east of London, during 1828-30. This was expressly for the use of the heaviest traffic to and from the East and West India docks, and had granite blocks 16 inches wide, 12 deep, and 5 or 6 feet long, the intermediate space being paved with small sets. The reduction of friction was so great that it was estimated two horses could do the work that required three upon an ordinary macadamized road. The loaded wagons worked over this tramway weighed about five tons (11,200 pounds). It continued in use for many years, although the route is nearly level, and no special reason, except the heavy nature of the traffic, existed for its maintenance.

About the same time stone tracks were laid on the high-road between Coventry and Nuneaton, two busy towns in Warwickshire. In this case the blocks were only 12 inches wide, 9 deep, and 3½ feet in length, the intermediate space not being paved. There was a great deal of coal traffic by carts, a sort of work which cuts up ordinary roads badly. The distance from Coventry to Nuneaton is about eight miles, and the cost of laying such trams slightly exceeded £1,500 per mile. This, of course, would mainly depend upon the nearness of the quarry.

Such tracks, however, have seldom been laid for any considerable distance along British country roads. In almost every town, nevertheless, there are lengths of stone track, both in streets and backyards, that would probably amount to a considerable total if carefully reckoned up. In London there must be scores of miles of them. Almost every riverside wharf has one, and at the towns bordering on the Thames the same applies. At Brentford, in particular, there are a great many of them. Their age is uncertain, but many of the alleys through which they go contain houses fully two hundred years old. So lately as 1890, the bridge over the Thames at Battersea, London, was constructed with a stone track on each left-hand side, as far as the center. The blocks are 4 feet apart, 1 foot wide, and 4 or 5 long. The gradient is 1 in 31 on both sides. On the other hand, Southwark bridge, which is much steeper than that on the city side, has no track, and in consequence has always been more or less useless.

Some very massive stone tracks may be seen at Liverpool, in North John Street, and Exchange Street East, for example. The blocks are as much as 2 feet wide, 6 feet apart center to center, but the rise in both streets is so slight that they are not much wanted. The curious old goods yard of the London and Northwestern Railway at Edge Hill, Liverpool, has a fine stone track running up to the street level at Smithdown Lane. It appears to be part of the original Liverpool and Manchester Railway of 1830. An interesting bit of stone track runs from the Edgeware Road, London, down to the coal-yard at Kilburn Station, London and Northwestern Railway. It is made of the stone blocks used as sleepers when that line (then called the London and Birmingham) was opened in 1837, placed close together. A remarkable form of stone railway may still be seen in Devonshire, although a good deal of it has been wantonly destroyed within the last ten years. It ran from the head of the Stover Canal, near Newton Abbot in South Devon, by a circuitous and steeply rising course up to the Heytor Rocks on Dartmoor. These rocks are of the granite formation common about there, and rise in a very singular and rugged shape on the top of the down. They are visible, rising to 1,491 feet above the sea, for miles around in all directions. The railway was made by a Mr. George Templer, of Stover, for the purpose of bringing down stone to the canal, which is a small, shallow one made by his father in 1792-4. Blocks of granite, generally about 15 inches square but varying in length from about 4 to 8 feet, laid end to end, have a step or rebate cut on the outer edge, to form a wheel track. This step is about 4 inches wide usually, but probably has worn inward somewhat by the grinding action of the wheels. No means of preserving the gage are adopted, nor are the blocks attached to each other in any way. Except a certain tendency, especially of the shorter blocks, to sink at the ends when the ground was soft after rain, the line seems to have preserved its gage and level remarkably well, though no very high standard of either was required. Some two miles of it at the lower end disappeared about 1862, the course being taken for the Moreton-Hampstead branch of the South Devon (now Great Western) Railway; but after getting clear of the pottery works near Bovey Tracey, the tram will be found crossing the road on the level and following a lane for a considerable distance. It renders this lane quite useless for any but pedestrian traffic. A narrow brook is crossed by four huge blocks laid side by side, the center ones having each a groove for the wheels; the wagoners probably used the outside ones for a footpath. A wide moor succeeds, where the tram is so densely overgrown as to be hard to find, then it runs through the estate called Yarner, and out onto the bleak top of Dartmoor. Here it is very perfect and readily visible, the wind blowing so continuously up there that nothing grows except fine grass, which leaves the stones bare. There are several branches to different faces where the stone used to be won, at about 1,200 feet above sea, but some 300 feet below the actual summit of Heytor Rocks. Except that the iron tongues or points that guided the wheels at the junctions are gone, the line is practically as good at the top as it ever was. It was opened for traffic on September 16, 1820, the quarries being worked by the Heytor Granite Company. For some years they did a large trade in London, landing the stone at Grosvenor Wharf, Westminster. The west face of London Bridge (opened 1831) is of Heytor granite, also the columns of the General Post Office (1829), and the Waithman obelisk at Ludgate Circus (1833). The stone is a fine-grained porphyritic rock, which can be

got in blocks of almost any size, but from the tie of the jointing is costly to quarry. This fact, and the competition of quarries nearer the sea, ruined the Dartmoor granite industry, and Heytor has been disused nearly fifty years.

The gage of the tramway was apparently 4 feet between the faces of the ledges or rebates which guided the wheels; but some blocks have tilted outward a little from the load not coming in the center line. The fall from the quarries to the canal must be at least 1,000 feet, so that loaded wagons ran alone a large part of the distance. They were very small and low, on four cast iron wheels nearly 3 inches broad and 2 feet in diameter. The leading vehicle was fitted with removable shafts for a horse. Other horses were, no doubt, sometimes used in tandem fashion. The absence of cross sleepers was, of course, very advantageous in horse traction, for which they are greatly in the way. Quite five miles of the course of the line are readily traceable, over the greater part of which the blocks were still down two or three years ago. Although it is a single line, there was not more than one passing place in that distance. A walk of about three miles from Bovey Station brings you to Heytor, where the most perfect part of the line remains, and the view from the top of the rocks, above it, is extremely fine on a clear day.

Some 16 miles southwest from Heytor are the remains of another derelict railway, formed by an Act of Parliament of 1819 for bringing down stone from Dartmoor to Plymouth. This was mainly laid with cast iron fish-bellied rails, but some of the sidings or passing places have short pieces of granite rail. In this case, the wheels having flanges in the usual way, the top of the blocks is dressed to a surface along the inner edge. The greater part of this line was opened in 1823; a small portion near Plymouth is still in use, and the company owning it, the Plymouth and Dartmoor, can boast of being the oldest railway company in the world.

In the American Cyclopædia, 1875, article Railroad, it is stated that on the Quincy Railroad in Massachusetts, opened in 1827, there were stone rails at the level crossings, the line being a short one for quarry purposes, like those just mentioned. There can be little doubt that good stone, in sufficiently large pieces, would be a stronger material for railway construction than the very light iron rails then used, where heavy weights and horse traction were used in combination.

Aeronautical Notes.

On Tuesday, the 10th instant, the first new military dirigible balloon to be constructed in England for the British War Department made its trial trip near Farnborough. Two trials of the airship were made on this date. In the first one, after a flight of about two miles had been made around Farnborough and Cove Common, the engines stopped, and the balloon settled down near some trees. The aeronauts threw out all the ballast (800 pounds) without being able to get the airship to rise. In this test the new dirigible stemmed a wind of fifteen miles an hour, navigating against it without difficulty, and traveling over the ground at about five miles an hour.

In the second trial the airship performed different evolutions, and completed a three-mile circle at a height of about half a mile. It afterward descended successfully near its shed.

This new dirigible is said to consist of a sausage-shaped balloon about one hundred feet long by thirty feet in diameter, which gives it a lifting capacity of about two tons. The balloon is provided with a framework of aluminium covered with canvas, on which are carried the engines and other apparatus. An arrangement is provided for keeping the balloon distended by means of ballonets, which are inflated in the usual way by blowers operated by the engines. Three men can be readily carried by this new airship.

M. Bleriot made a successful flight with his new aeroplane above the drill grounds at Issy, France, on the 17th instant. After running along the ground for a distance of about 75 yards, the machine rose to a height of some 50 feet, and flew a distance of 598 feet. The motor stopped working, and the aeroplane settled down rather abruptly, which damaged it somewhat and cut the daring aviator about his head. The distance covered in this flight is the nearest approach to Santos Dumont's record of 689 feet.

Thirty-four balloons ascended in clear air and, carried by a light wind, drifted southward over the field of Waterloo in an international balloon race that was started from Brussels, Belgium, on the 15th instant. This race was conducted by the Belgian Aeronautic Club, the prize being a silver cup donated by the club. The German balloon "Pommern," piloted by Herr Erbslob, won the race by descending at Bayonne, France, 621 miles from Brussels. A Swiss balloon was second, landing at the foot of the Pyrenees after covering a distance of 565 miles. Prof. Huntington, of England, was third, with a distance of 553 miles to his credit, while Mr. Rolls with another English balloon, the "Britannia," was fourth with 534 miles, the balloon landing at Sanguinet. An Italian balloon piloted by Usuelli covered 515 miles, and Herr von Abercron's German balloon came down at Carcans, 481 miles from Brussels. The contest was an extremely interesting one in view of the large number of balloons that competed.

The United States Army Signal Corps officers have recently established a balloon corps. This corps will be under the immediate charge of Capt. Charles De F. Chandler, and will also be under the tutelage of Leo Stevens, the well-known aeronaut and balloon constructor. It is planned to make ascensions from Washington in one of the new army balloons. It is also expected that within the next few months systematic ascensions and test flights will be made at Omaha, Neb., where the Signal Corps has a station, and where special arrangements have been made for the manufacture of compressed gas to be used in the balloons. The new corps will endeavor to learn in a practical way the advantages of the balloon for scouting purposes. In time, no doubt, this branch of the army will experiment with dirigible balloons and with aeroplanes, in the same manner as is being done by the leading foreign governments to-day.

Correspondence.

Apprenticeship System on the Pennsylvania Railroad.

To the Editor of the SCIENTIFIC AMERICAN:

I am in receipt of a letter signed W. S. Vanover, written from Lexington, Va., inclosing a letter from you to him under date of September 6, 1907, in which you advise him to enter the railroad university conducted by the Pennsylvania Railroad Company at Altoona.

There seems to be a pretty general misunderstanding as to what the Pennsylvania Railroad Company is doing in this respect at Altoona; and I thought it advisable, therefore, to let you know exactly what we are doing. Your letter referred to is certainly misleading. We do not conduct a railroad university at Altoona, in the ordinary acceptation of that term. What we do is as follows:

Young men, graduates of technical schools, either in the mechanical or engineering departments, are taken into our service in the mechanical departments as special apprentices, serving a period of four years in the different shops, offices, and laboratories of the company, thus fitting them for positions of responsibility with the railroad company.

In the engineering department these young men are employed as rodmen, from which position they are promoted according to seniority and ability to transitmen, assistant supervisor, and so on up into positions of importance and responsibility with the company. The maintenance-of-way men do not serve any fixed time in any of the positions referred to, but they are advanced accordingly as the vacancies occur and their abilities fit them for.

It will be observed from the above that we do not maintain a university or a school, in the ordinary acceptation of the term.

At Altoona, however, in connection with the public school system there is a manual training school, the higher branches of which are conducted in connection with the Altoona High School; and it is proposed to have this manual training course include a post-graduate course of approximately two years, thus giving special training to graduates of the high school in mechanical work, so as to make them better fitted for mechanical positions, not only with our company, but with any company with which they desire to become connected. The Pennsylvania Railroad Company is interested in this manual training school only to the extent that it increases the available material for them to draw upon for a higher class of mechanics; and for this reason the Pennsylvania Railroad Company donated a sufficient sum of money to properly equip the manual training school in the high school building.

G. W. CREIGHTON,
General Superintendent.

Test of Wellman's Airship in the Arctic Regions.

The following account, by Mr. Walter Wellman, of the first flight of his airship "America" in the Arctic regions may be of interest to our readers, in view of the fact that this test was the culmination of two winters spent in preparing the airship and two summers spent at Dane's Island with it in an effort to get it ready to start for the pole. The start was finally made on the 2d instant, and the following is a dispatch to the Lokal Anzeiger of Berlin, sent by Mr. Wellman from Tromsoe, Norway:

"After the steamer 'Express' cast off the cable, the balloon 'America' did excellently, but an increasing wind soon gave us a hard struggle, and the storm drove us toward some high, jagged mountains near the coast, where the airship would have been destroyed if she struck.

"There then ensued a hard fight between the storm and the motor. The latter triumphed, and we slowly rounded the north end of Foul Island in the teeth of the wind. Our confidence in the 'America' had so increased in the meanwhile that I gave the order to start for the north pole.

"The wind, however, increased to twelve miles an hour, and the snow fell so thickly that we could not see a quarter of a mile. Just then the compass failed to act owing to defective construction. We were completely lost in a snowstorm above the Polar Sea and threatened with destruction. After a brief deliberation we decided to try and get back to the 'Express' to rectify our compass and start again.

"It was impossible, however, to keep in one direction, and we were again carried into dangerous proximity to the mountains. Vaniman, the engineer, then started the motor at top speed, and the 'America' moved a second time against the wind, which probably was blowing fifteen miles an hour.

"She circled three times in the teeth of the wind. We saw the 'Express' for a moment, but immediately lost her again. We would have returned to the 'Express' if we could have seen where to steer, but under the circumstances the only thing possible was to try to land. With this idea we stopped the motor and let the 'America' drift over the glacier.

"At the end of Foul Bay we used a trailer filled with provisions and a brake rope. Both acted well and dragged over an ice wall 100 feet high without damaging the provisions.

"After crossing the glacier we opened the valve, and landed on the upper glacier, half a mile inshore. The landing was effected so successfully that material weighing nine tons descended three hundred feet and touched the ice with no shock or damage whatever excepting several bent tubes and broken wires. The numerous delicate instruments were not injured. The self-registering barographs, meteorographs, and manometers continued running after the landing. The mantle of the balloon can easily be repaired.

"The 'America' was in the air for three hours and fifteen minutes, and covered about fifteen miles with her own machinery. She made three loops against the wind, proving her power and capability of being steered. The ascent was successful in every respect. The 'America' is from every standpoint the strongest airship and the most durable for a long journey that ever was built. She held the gas splendidly.

"Later in the same day the 'Express' found us, and fetched the steamer 'Frithjoff,' with men and sledges from the camp. The crew of the 'America' lived for three days comfortably in the gondola while the work of rescuing the balloon was in progress. They could have lived there for nine months had it been necessary. The entire airship, including even a part of the gasoline, was returned to the camp in three days.

"The balloon and the entire outfit have been made ready for the winter, and three men have been left on guard.

"After this successful attempt we were all convinced that the 'America,' in normal summer weather, can make her way to the pole. We all regard this plan as rational, practicable, and feasible. The thing can be done, and what can be done shall be done."

The Current Supplement.

Advances in the construction of telescopes and other astronomical instruments have enabled scientists to make new discoveries far surpassing those made even a few years ago. "Recent Progress in Astronomy" is interestingly written about and fully illustrated in a lengthy article in the current SUPPLEMENT, No. 1656. The efforts made to obtain turpentine and other products from waste wood are described by J. E. Teeple, Ph.D., and J. S. Miller writes on asbestos, a useful mineral, of which the supply is insufficient. Few toolmakers know how to test with any precision the grade of a bar of steel. In an article on "The Spark Method of Grading Steel," Albert F. Shore, M.E., describes a method of testing steel with an air blast. The first of a series of practical articles on the "Elements of Electrical Engineering" is written by Prof. A. E. Watson, and an illustrated note on "Automatic Speed Control for Magnets" will also be of interest to electricians. The Cape to Cairo railway, dreamed of for years by Cecil Rhodes, is gradually becoming fact; from its southern end it now stretches through northwestern Rhodesia toward the Congo Free State frontier. Our English correspondent describes and illustrates one of the features of this length of line—the building of the longest bridge in Africa. The fifth of J. H. Morrison's articles on "The Development of Armored War Vessels" brings us to the verge of modern construction. Dr. A. Gradenwitz contributes a valuable note on the "Cause of Vitiation of Confined Air." We have several times lately referred to archæological research in northern Africa; much of this work has been done by European investigators. In the current SUPPLEMENT the Egyptian work undertaken by the New York Metropolitan Museum is described.

DANIEL'S COMET.

Comets are not exceedingly rare visitors, but it is seldom that they are prominent enough to be visible to the naked eye. Not in twenty-five years have we had the opportunity to observe as large a comet as has been conspicuous in the eastern skies each morning for the past two months. It is owing to the fact that the object could be seen only in the early hours before sunrise that it has awakened so little public attention. Since our issue of August 31, in which appeared a description of Daniel's comet, it has arrived at perihelion (its closest approach to the sun) on schedule time, the 4th of September, and is now speeding away at a pace that will soon carry it beyond the reach of the naked eye. As its course is a parabola, we will probably never see it again.

PHOTOGRAPH OF DANIEL'S COMET TAKEN AT YERKES OBSERVATORY. NOTE THE GREAT LENGTH OF THE TAIL STREAMERS.

One would suppose that after rounding the sun the comet would pass from the east side to the west of the sun, and be visible in the evening skies. However, this is not the case, because the earth has followed the comet far enough around to see it strike away still on the right hand or eastward side of the sun. At present writing the comet is visible to the naked eye, although it is so nearly in line with the sun as not to be very conspicuous. It rises at about 4 o'clock in the morning, but before it ascends above the dense and murky atmosphere of the horizon sufficiently to be clearly observed, it is overtaken by the first rays of dawn, and the faint nebulous tail can scarcely be distinguished against the bright background of the sky. However, the head or nucleus of the comet is clearly visible, and appears like a second-magnitude star, or as bright as the stars which make up the Great Dipper. Shorn of its tail the object bears little resemblance to the popular notion of a comet, and it is difficult for a layman to identify it unless he knows just where it is to be found.

The comet when first sighted by Daniel at the Princeton Observatory, on June 9, was of the ninth magnitude. By the 7th of July it had grown to the sixth magnitude, so that a practised eye could just make it out without the aid of the telescope. Its nearest approach to the earth occurred on the 1st of August, when it passed within 70 million miles of us. It was then 85 million miles from the sun. At perihelion, on September 4, it was 48 million miles from the sun, and 80 million miles from us. When at its most favorable position for observation, it grew nearly as bright as a first-magnitude star, and had a tail which appeared as long as the handle of the Great Dipper. In some photographs it can be traced to a much greater length. The head, including the nebulous aureole, was of about one-third the apparent diameter of the moon. The real diameter of the head was about 236,000 miles, or almost thirty times the diameter of the earth. The tail appeared to have a length of 20 million miles, but as it was not perpendicular but oblique to the line of sight, its length was evidently much greater than this.

At a number of the principal observatories photographs of the object were taken nightly whenever the weather was favorable, and as long as the position of the comet with respect to the sun permitted. These photographs, put together, form a pictorial diary of the comet. Camille Flammarion, comparing the photographs taken at the Juvisy Observatory, has noted that the luminous streamers of the tail varied their position on successive nights, which leads him to believe that the tail was rotating on its axis. This, however, is doubted by other observers. The photographs shown herewith were taken at the Yerkes Observatory at Chicago, and show two characteristic phases of the comet's tail. As the photographs were made with the telescope trained upon the comet, the stars appear as lines of length proportional to the duration of the exposure, that is, they show the relative eastward motion of the comet. The eastward side of the photographs is shown at the left instead of the right, because to see the comet in the position illustrated, the observer would have had to face toward the south.

ANOTHER VIEW OF DANIEL'S COMET. THE STAR STREAKS OF THE BACKGROUND SHOW THE MOTION OF THE COMET WITH RESPECT TO THE STARS DURING TIME OF EXPOSURE.

As is usual when a conspicuous comet makes its appearance, the daily press has published sensational and alarming predictions of the possible consequences of a collision between this earth and the comet. Some one has stated, and very truly, that the chances of our earth ever being hit by a comet are about the same as the chances of one's killing a bird on the wing by firing a gun blindfolded at the open sky.

The nucleus of a comet is probably made up of a swarm of meteorites, and the tail is made up of a very fine dust, and not a gas as is commonly supposed, which is driven off from the nucleus by the repulsive action of the sun's rays. As comets' tails often stretch out for many millions of miles, the chances of our passing through one of them are far greater. But should we ever encounter a comet's tail, it is doubtful if any laymen would be the wiser, and the fact could be determined only by mathematical calculations. The earth would not be enveloped in noxious gases, or in white-hot matter, because the indications are that comets' tails are comparatively cold, and shine with a certain glow due to the action of the sun's rays on the minute particles. The only visual evidence we could possibly have of passing through the tail of a comet might be a shower of shooting stars; and since the particles which make up the tail of a comet are exceedingly minute, they would be entirely consumed by friction with the earth's atmosphere long before they came within reach of the ground.

Cariboo District.

The central part of British Columbia, during the years 1860 to 1870, or thereabouts, produced some $40,000,000 of gold from very rich shallow placers, mined by very primitive methods. The movement of prospectors to this region was known as the Cariboo "excitement" or "stampede," and probably, area for area, there was then a greater amount of gold collected from the above region than any other equal area ever discovered, not even excepting the rich creeks of the Dawson region in Yukon Territory. Williams Creek, in the Cariboo District, is said to have produced upward of $25,000,000 from a length of 2½ miles of its creek bed, according to government records. The attention of capitalists is again being largely directed to this district.

There is a false impression extant that mining can be carried on in this region for only a few months in the year. While the eastern part of British Columbia receives a large fall of snow varying from 30 to 40 feet per year, in the western part the snowfall amounts to only 4 or 5 feet. The climate of central British Columbia is very mild, due to the warm and persistent Chinook winds coming from the Japanese current.—Mines and Minerals.

In a recent six-hour test at the refuse-burning plant which generates light for the Williamsburg Bridge, New York, 40,497 pounds of refuse was burnt, or at the rate of 6,749 pounds per hour. The total bulk of the refuse burnt was 293 cubic yards, weighing 138 pounds per yard. It was burnt under two 200-horse-power Stirling water-tube boilers; the total grate area was 192½ square feet, and the consumption of refuse per hour on each unit of surface was 39.2 pounds. The heating surface of the two boilers was 3,780 square feet, and the steam pressure during the test was 143 pounds per square inch; 2.29 pounds of water were evaporated for each pound of refuse burnt from and at 212 deg., this result being due in part to the economizers on the boilers. The consumption was 46 pounds per kilowatt hour, due to the fact that only part of the power produced was used to generate current, though the boilers were run at their full capacity.

During 1896 the United States imported 77,194 short tons of asphalt from Trinidad. This material is obtained from a pitch lake, and as it is removed the supply is replenished from subterranean sources.

IF INSECTS WERE AS LARGE AS ELEPHANTS.

If modern man had existed in the period of the giant lizards, it is possible that he might have had a clearer conception of the strenuous life than he actually possesses. This thought is suggested by the ingenious humor of our contemporary, the London Sketch. In the SCIENTIFIC AMERICAN of May 25, we published a number of illustrations of insect models from the American Museum of Natural History. Our contemporary, noticing these fearsome "beasts," conceived the idea of introducing some of them into pictures with men and women, where the insects would outrank the humans in size. The results are so entertaining, that for once we rather extend the scope of our pages, and reproduce these pictures for the amusement of our readers.

The idea is not new; a few years ago an English author wrote a novel, in which the discovery of a wonderful concentrated food led to a growth of hornets a yard long, and rats as big as horses. The final result of this upsetting of nature's balance was, that man adapted himself to the new order of things, and continued to control nature. The conclusion was a correct one.

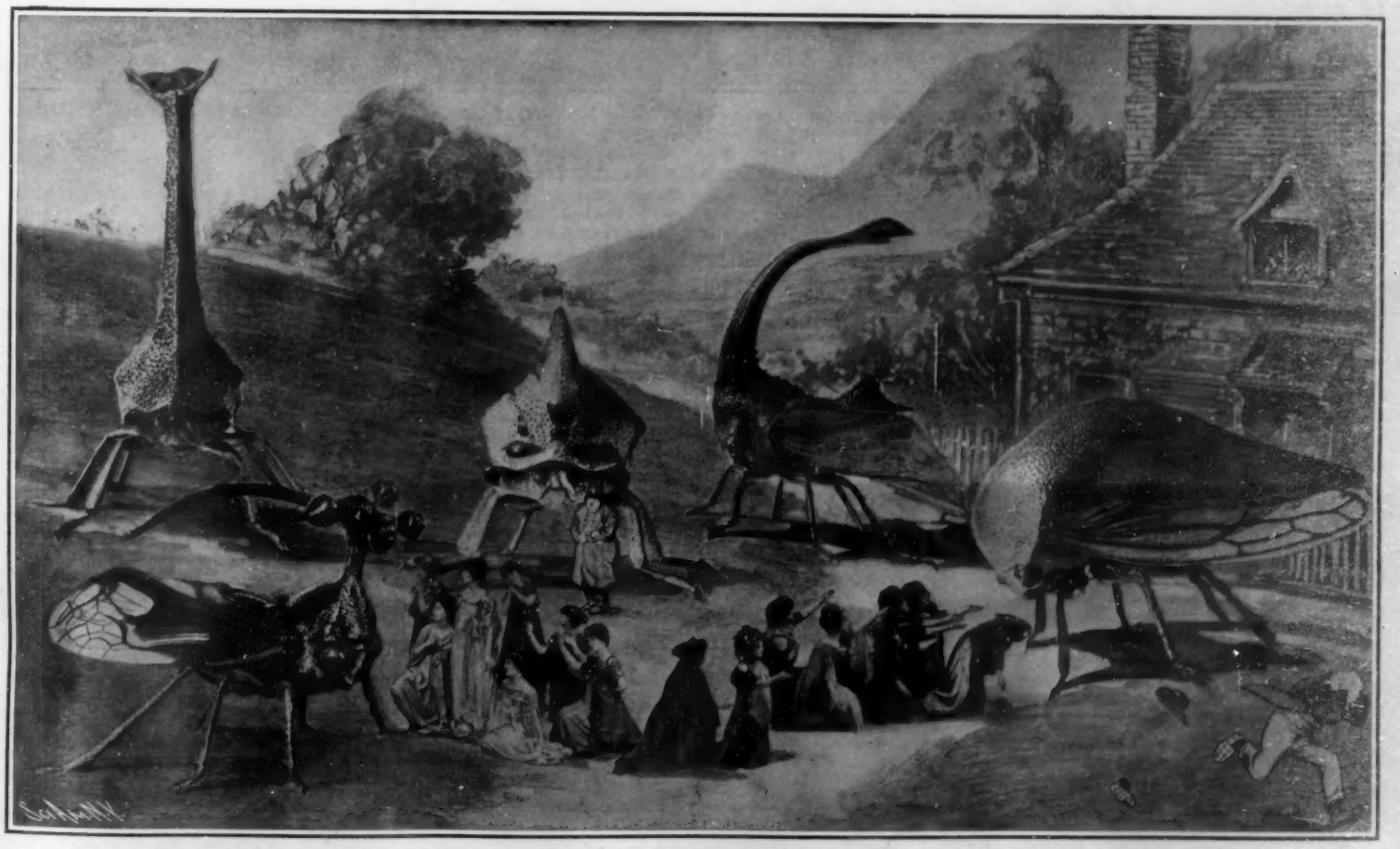
If, through the working of some miracle, we were suddenly deluged with monster insects, the infliction would probably be less terrible than appears at first glance. The larger an animal becomes, the less able is it to stand against man. The elephant, which lives to a century and can kill a man with a blow of its trunk, will soon be extinct, unless means are taken to preserve it, while a small creature such as a rat or a mouse holds its own in the busiest city. The bison has vanished from our prairies—a victim to its size. If mosquitoes grew to resemble greyhounds, it is fair to assume that they would no longer lay innumerable eggs, as they do at present. Both the larvæ and the flying insects would be fair game for sportsmen, and probably in a year or two the insects would be extinct—except in our zoos. It is not the visible which is terrible to man. Wild beasts, storms, or accidents account for comparatively few disasters. It is the minute and unnoticed that spreads disease. For centuries man has suffered from the ravages of plagues—suffered chronically and as a matter of course—to an extent scarcely conceivable to this generation. The nineteenth century was well advanced before people began to fairly understand what are now considered the very rudiments of health; now our scientists have got a firm grip of the situation; and if some new condition arose, they would gradually find means to control it.

The illustrations suggest feelings of regret rather than teror. Those tree-hoppers appear to be placid, amiable creatures, and we cannot believe that either the beseeching damsels or the terrified policeman are in any danger of furnishing a meal. If only we could capture a few of them, and break them in to work, we might find that we had tapped a practically inexhaustible supply of cheap horse-power. The beetle is more terrible, for his intentions are evidently hostile. But we can well imagine him changed from the hunter to the hunted. Those ferocious jaws of his might solve the problem of the diminishing supplies of whalebone, and his wing membranes might supersede crocodile hide for purses. Doubtless a use would be found for every part of him, and he would soon grow scarce. The tree-hoppers have four wings. They would solve a vexed problem for us. We may imagine a long line of "heavier-than-air" fliers racing over a measured course in competition for the "blue ribbon of the air," the SCIENTIFIC AMERICAN trophy.

Country Life—As It Might Be.

A report has just been made to the Paris Academy of Sciences by Dr. Fortin, an eminent optician of France, which is now attracting the attention of physicians throughout the civilized world, inasmuch as disease of the eye has been the most difficult to contend with in all the range of medical and surgical science. Dr. Fortin's new contrivance in the diagnosis of the eye is a confirmation of the physical organization of our organ of vision, a practical application of which has been the dream of students in this branch of science for years. The physicians who are investigating Dr. Fortin's theory find that the light from a mercury-vapor lamp passing through two sheets of blue glass and reflected into the eye by a large lens reveals the internal condition of the eye infinitely better than ordinary white light. By placing a screen with a pinhole between the light and the eye, a magnified image of the vessels at the back of the retina, which has heretofore been invisible, has been obtained. This discovery in optics is regarded as one of the most advanced steps in this field of science, judging from the comments of eminent physicians on the recent report of the French Academy.

The multiplication of hotels in New York has not resulted in an oversupply of accommodation, as many old-line hotel managers have feared. The latest notable building is the new Plaza Hotel, which opened on September 23. A few years ago a large modern hotel was erected on this site, but the owners saw possibilities for improvements, and so the old Plaza Hotel was razed to the ground and the new one built; the cost, including the scrapping of the former building, is about $12,500,000. The success of the investment seems assured.



Fortunately the Tree-Hoppers Are Herbivorous, But Their Aspects Are Sufficiently Strange to Inspire Terror in Timid Bosoms.

A composition from The London Sketch adapted from specimens previously published in the Scientific American.

IF INSECTS WERE AS LARGE AS ELEPHANTS.

THE NEW FASTNET ROCK LIGHTHOUSE.

Off the southeast corner of the coast of Ireland is the Fastnet, a small pinnacle, which is one of the most important landmarks to transatlantic traffic, constituting as it does the first and last land bearings to and from Europe. This danger spot comprises a group of islets, the principal of which are the Great and Little Fastnets, and before the year 1848 was in no way indicated to mariners. In that year the erection of a cast-iron tower to a height of 64 feet was commenced by George Halpin, engineer to the Irish Lights Commissioners, fitted with a 38,000-candle-power flashing light recurring every two minutes, at a cost of $86,950, and the light was shown for the first time on January 1, 1854, thereby superseding the light on Cape Clear, 4½ miles away on the mainland.

This structure proved unable to withstand the strain put upon it by the Atlantic, and frequent and costly strengthening works were necessary. Finally, in 1895, it was decided to supersede the old erection with a more modern masonry-built house. The situation of the new lighthouse upon the rock may be gathered from the accompanying illustrations, and it will be seen that it rises from a ledge just above the water level. At its base the tower has a diameter of 52 feet, and the granite portion rises to a height of 147 feet, the focal plane of the light being 159 feet above high-water mark at ordinary spring tide. The site selected is the hardest portion of the rock, and being at the extreme west end of the islet, the base of the tower receives the blow of the heaviest seas before they rise to their full height. The foundations are 20 feet in thickness, comprising thirteen partial rings of masonry, forming a facing to the natural rock. The lower courses are stepped, and help to offer a vide bottom ventilation to the lantern and may be left open in all weathers without any danger of spray being driven in. This room is fitted with a rain-water tank, which collects the water falling on the lantern roof, and with the wireless telegraph apparatus, for this lighthouse constitutes the most westerly and important shipping signaling station in the British Isles.

The external form tapers upward for a height of 116 feet in an easy curve, which is the segment of an ellipse having a semi-axis major of 155 feet. Above this point the shape is cylindrical, 20 feet 8 inches in diameter, with two balconies projecting outward, of 26 feet external diameter at the 133 feet 6 inches and 146 feet 3 inches levels respectively, the masonry being carried out in an easy curve under each balcony.

The whole of granite for the masonry was procured from Cornwall, and the lighthouse was set up in sections at the quarry to secure accurate fitting. For the lower course, where the stone would soon become covered with green seaweed, fineness of grain and color were of secondary consideration so long as the texture of the stone was of a high standard. For the section above the entrance level good hard fine-grained granite of uniform color, free from marks and defects, and very finely dressed so as to present a good flat surface on either face, is used. The whole of the stones were carefully dovetailed together upon the dovetail joggle system, so that the entire structure is bonded into virtually a monolith. It is impossible for any stone to be withdrawn until the whole of those above have been removed, when it is extracted in a vertical direction; and even such action must break off the dovetailed joggle in the course below it, as the cement used in the bed flows in and completely fills the space between the male and female dovetails, remedied by careful cutting out and cementing in of small stones. Each course was carefully checked after laying, and the greatest variation from the figured dimensions of the drawings was only 0.25 inch in the entire diameter, which speaks well for the care and labor bestowed upon the cutting of the blocks.

The lantern equipment is by Messrs. Chance, of Birmingham. It is of the single flash type, recurring every five seconds, the duration of the flash of maximum intensity being 0.122 second. The power of the beam during this period of flash is 750,000 candle-power, and is obtained by means of a biform four-sided apparatus, each tier consisting of four square panels with annular plano-convex lenses of 80 deg. aperture and 920 millimeters (35.5 inches) focal distance. In the center of each tier is placed an incandescent mantle burner of special design, having a minimum and maximum working power ranging from 1,350 to 1,450 candle-power, respectively. The lenses are set forward with their principal foci on the horizontal axis, and 6 millimeters (0.236 inch) in front of the vertical axis of the mantle, this disposition being found to give the best results in the photometric tests, as more light is received from the front than from the back of the mantle, the proportions being respectively 62.5 and 37.5 per cent. The catadioptric prisms are divided into short segments, and each segment is set to throw the center of its beam in a direction truly parallel to the center of the beam from the lens, the latter being dipped to strike the sea at a distance of ten miles by raising the center of the mantle the requisite height above the horizontal axis of the lens. By the adoption of the biform apparatus, should an accident befall one of the burners, the whole light is not extinguished—the beam is only

Gear for Hoisting and Setting the Masonry Blocks.

One of the Solid Masonry Courses of the Tower in Course of Construction. (View from Top of Rock.)

The Lantern in Course of Construction.

THE FASTNET ROCK LIGHTHOUSE.

breaking face by their sharp edges to the waves. At the top of the foundation courses the diameter is 40 feet, and here the complete courses of masonry commence, being continued up to a height of 30 feet 6 inches. These courses are solid except for a central fresh-water tank of 3,250 gallons for the keeper's requirements. The tank is divided into two compartments by a central brick wall, so that one side may be emptied for cleaning without wasting the store in the other compartment. The floor of the entrance room to the light-house is 57 feet 9 inches above high-water mark. Up to this point the thickness of the masonry courses varies from 2 feet, in the case of the foundation partial ring courses, to 1 foot 9 inches thick for the succeeding fifteen solid courses to the entrance room floor. From the entrance level the tower extends to a height of 88 feet 1½ inch to the lantern, and is divided into eight compartments for the services of the inmates.

The four lower floors are used for storage purposes. The second room contains the oil tanks, from which the oil is pumped to a small supply tank in the lantern gallery. From this floor commences the central hollow shaft, in which the weight controlling the revolving mechanism of the lamp moves. The fifth-floor room is the living room, 15 feet in diameter, and above is the principal bedroom. Access is gained to the various apartments from the entrance level by a spiral staircase. The rooms are all well lighted by windows fitted in gun-metal frames up to this level, and protected upon the exterior by storm shutters, the outer surfaces of which come flush with the masonry. Immediately below the lantern is the service room, from which the lower balcony is gained. The windows in this room are not equipped with storm shutters, and have special louvre ventilators over them, which pro- The total number of stones used in the building of the tower is 2,074, representing a net cubic content of 58,093 feet and a weight of 4,300 tons. The weights of the individual stones range from 1¾ to 3 tons. In addition, 4,500 cubic feet of small squared blocks were used in filling cavities in the foundation and the space between the rock and the tower up to the level of the entrance floor.

Owing to the inaccessible position of the rock and the danger involved in approaching except in the calmest of weather, great difficulty was entailed in the work of construction. A special steamer was built for trans-shipping the building material, workmen, and stores to the rock from the mainland. As the vessel could not approach nearer the islet than 110 feet, special gear was installed for transporting the stones from the ship to the point of erection. A derrick was rigged up on the rock, to haul the stones from the steamer to the base of the tower. When the stone reached the base, it was picked up by another derrick fixed up in the center of the building, and lowered into the position in which it was to be set. The laying of the lowest courses was frequently delayed, owing to the rough weather experienced, but whenever the weather was fine excellent progress was maintained, the greatest number of stones laid in connection with the lowest courses in a single day being 22. The actual building commenced in July, 1901, operations having been retarded considerably by difficulties experienced in connection with the quarrying of the granite, and afterward by inclement weather.

The setting of the masonry was completed in just four years. During the work, despite the difficulties attending trans-shipment of the masonry to the rock, not a single stone was lost or damaged beyond slight chips off the rises of 16 stones, which injuries were reduced fifty per cent in power. Moreover, a flash of greater intensity can be secured thereby, while the principle also facilitates cleaning.

The pedestal of the lantern is of the type designed by Mr. C. W. Scott with mercury flotation. A cast-iron cylinder 5 feet 9 inches in diameter by 4 feet 6 inches in height, divided into six segments, supports six standards, on top of each of which are two vertical rollers on ball bearings, and one horizontal roller rotating on a pivot. Outside these standards is the mercury trough, supporting a float which carries a revolving table of 7 feet 6 inches diameter, on the inner curb of which is a gun-metal toothed rack of 5 feet pitch-line diameter. Within the pedestal is the shaft connecting with the weight-driven clockwork rotation machine, and also two air receivers and two oil bottles, which feed the burners. The weight of the revolving apparatus is 6 tons, and it is rotated by a 290-pound weight falling 49 feet per hour, this being sufficient to give three revolutions per minute, and the rate of variation of the speed of revolution can be easily maintained within five seconds in the hour. The maintaining gear is of the sun and planet type, and so designed that the speed of revolution does not vary while the clockwork mechanism is being wound up. The lantern itself is 17 feet in diameter at the inner surface of the glass by 27 feet high from gallery level to top of dome. Above the roof extend two electrically-fired fog signal jibs placed diametrically opposite each other. Provision had to be made to prevent the possibility of an explosive charge being accidentally fired by the telegraph transmitter of the Marconi station maintained on the lighthouse, and this prevents the telegraphic apparatus being in operation while fog signaling is in progress.

The lower portion of the old tower is now used as an

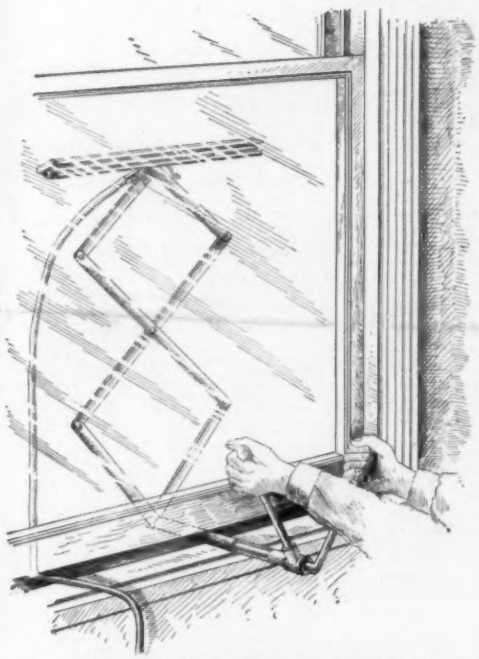
oil store, there being installed therein six 300-gallon cylindrical tanks in addition to five 130-gallon tanks in the lighthouse itself. The reservoirs in the old tower are connected to those in the lighthouse, a stop-cock being fitted to control the flow. The tanks in the old tower being higher than those in the new lighthouse, the oil gravitates from the former to the latter. All tanks are fitted with gages for determining the quantity of oil within. The oil is landed in barrels, and pumped into a 40-gallon sump tank having a removable cover and fine wire-gauze strainer.

The total cost of the undertaking somewhat exceeded the original estimate, owing to the difficulties encountered, aggregating $420,000. The staff for the lighthouse comprises four men, relieved twice a month, weather permitting. The cost of maintenance averages about $5,000 per year, to which $1,000 is contributed by Lloyd's for the privilege of using the lighthouse as a signaling station, this being the first point from which incoming vessels on the Atlantic are notified to London and Europe. The cost of oil and mantles for the burners averages approximately $225, and fog-signal ammunition about $1,300 per year.

The superintendence of the building was intrusted to Mr. C. W. Scott, engineer to the Irish Lights Commissioners; he also designed the special form of lamp used.

A DEVICE FOR WASHING THE OUTSIDE SURFACES OF WINDOWS.

There has long been need for some simple and practical device for washing the outside surfaces of windows. This need has greatly increased in late years with the increased height of modern buildings. The



DEVICE FOR WASHING THE OUTSIDE SURFACES OF WINDOWS.

inaccessible exterior surfaces of the windows makes the work of cleaning them especially inconvenient and hazardous, so that trained experts are now commonly employed for this service. In the accompanying engraving we illustrate a device with which the exterior surface of a window may be readily cleaned from within the building, and without imperiling the life of the operator. It consists of a cleaning head, which may be projected to the desired point by means of a lazy tongs mechanism that connects the head with the operating handles. The lower legs of the lazy tongs are respectively secured to a pair of rock shafts which are concentrically mounted, one shaft being tubular to receive the other. Each shaft is provided with a handle, and by swinging these handles toward and from each other the lazy tongs may be extended or retracted. A flexible hose connects the head of the washing device with a source of water under compression, so that a flow of water may be had at the desired point. A patent on this window-washing device has been secured by Mr. William G. Himrod, of Third and G Streets, N.W., Washington, D. C.

A NEW TYPE OF CAR FENDER.

The accompanying engraving illustrates a fender which is particularly adapted for use on street cars, and which is so designed as to present no unflexible portions against which a person may be injured when picked up by the fender. The fender comprises a frame supported on two bars *A*, by which it may be secured to the end of a car. The frame is formed of two L-shaped members, connected at suitable points by cross bars. In order to prevent a person from being injured by the front cross bar or pilot bar of the frame, a strap *C* is provided, which is placed directly before the bar and serves as a guard. The frame is covered with canvas. The fender comprises a forward slightly-inclined portion and a rearward sharply-inclined portion. The boundary between these two portions is marked by cross bar *D*. The canvas is secured to this cross bar in the manner shown in illustration, so that there will be little danger of injury to a person striking this part of the fender. In order

A NEW TYPE OF CAR FENDER.

to strengthen the canvas covering, it is provided with a number of reinforcing folds, so that there is no danger of the canvas giving away when the fender picks up an object or a person. The frame of the fender is hinged to the bars *A* at the points *B*, so that the fender may be lifted up into folded position when desired. The strap *C*, which is placed in front of the pilot bar, is supported at opposite ends on rollers in such manner that it may be moved when pulled in either direction, or when it happens to receive a glancing blow from an obstacle. While the fender is more particularly adapted for use on street cars, the inventor hopes to introduce it on automobiles. Mr. Shozaburo Ishii, of New York, N. Y., has procured a patent on this fender.

Ginseng and Belladonna Growing in California.

Recent investigations made by the State Board of Trade demonstrate that the growing of ginseng can be made very profitable in California, although the plant is not indigenous to the State. All the requisites of soil, moisture, and climate are to be found in California.

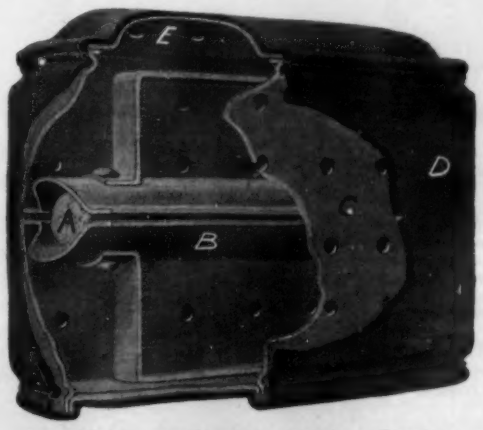
One tract of land located in Santa Clara County, containing over 100 acres, was planted in ginseng about two years ago, and gives flattering promise of good returns next year, when the first crop is to be harvested. Another tract in Marin County was planted a little later than the one in Santa Clara County, and now gives promise of yielding equally well.

Ginseng is a drug used as a basis for almost all Chinese remedies. It sells in the market in its natural state for about $8.50 a pound, while the fluid extract commands a higher price. The Chinese buy all that is to be had, and ship it to China. It is gathered in many eastern States and in the Ohio and Mississippi valleys.

Extensive experiments and investigations have also been made recently in the Gardens of Medical Plants in San Francisco, and at other points in California, in regard to the cultivation of the belladonna plant. These experiments show that it will grow very successfully in the State. There are movements now on foot to engage in its cultivation in California, on a very large scale. The raising, it is claimed, is decidedly profitable, as the price is good and the demand for this drug constantly on the increase.

HAND WARMER AND BODY HEATER.

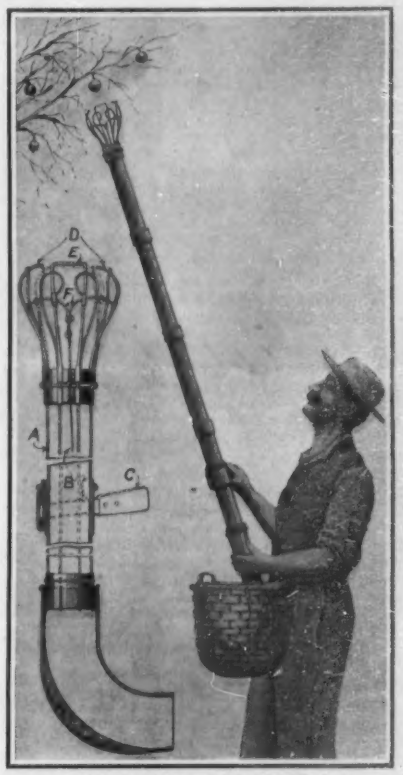
The heater which is illustrated in the accompanying engraving is of the type in which a slowly-combustible substance is inclosed, and after being ignited is carried in the pocket for warming the hands. The device may also be applied to any part of the body to alleviate pain. When so used the heater has material advantages over hot-water bottles, or similar devices commonly used. The combustible material within the case continues to burn for a great length of time, maintaining its heat until the material is entirely exhausted, whereas a hot-water bottle soon becomes cold and is of no further use until reheated. The particular advantage of the heater which we show herewith is that a special means is provided for holding the combustible substance in the center of a casing, so that one side will not become heated more than the other side. The combustible material, which is preferably punk prepared for the purpose, is inclosed in a paper cartridge *A*. The cartridge is supported in a holder *B*, which is provided with brackets adapted to hold it in a central position. Flanges on the holder project laterally therefrom, and serve to space the cartridge from the side walls of the casing. The casing *C* is formed with a series of perforations in the side walls. The cover *E* of the casing is also perforated. A lining of cloth is fitted against the under side of the cover, and the side walls of the casing are covered with cloth, as indicated at *B*. The construction is such that there will be no danger of sparks passing through the perforations in the walls and igniting the clothing of the user. A patent on this body heater has been granted to Mr. Philip Stein, 220 to 226 West Santa Clara Street, San Jose, Cal.



IMPROVED HAND WARMER AND BODY HEATER.

IMPROVED FRUIT PICKER.

Pictured in the accompanying engraving is an apparatus adapted to enable a person standing on the ground to readily remove fruit from a tree without



AN IMPROVED FRUIT PICKER.

injuring the fruit. It consists, briefly, of a long tubular member provided with a picking device at the upper end, which may be operated by a lever conveniently located near the hand of the operator. At the lower end of the tubular member is a discharging elbow, which opens into a basket or other receptacle carried by the operator, so that the fruit when picked will pass down through the tube and into the basket. The tubular portion is formed of a number of rods *A*, connected by collars at suitable intervals, and which serve to support a lining of any suitable textile fabric. The discharging elbow is provided with a soft cushioned portion on which the fruit falls without breaking or bruising. The picker arms at the upper end of the tube are operated by means of rods *B*, which lead to a lever *C*, fulcrumed near the lower end of the tube. The picking device comprises two U-shaped flexible arms *D*, formed by extending a pair of the supporting rods *A*. In addition to these there are a pair of arms *E*, located between the arms *D*. Attached to the arms *D* are links *F*, which pass over pulleys supported on arms *E*, and are connected to the operating rods *B*. The device may be used by placing the picking arms around the fruit to be picked, and then detaching the fruit by a downward or lateral movement of the picker without using the lever *C*. In most instances, however, the fruit is detached by drawing the picking rods inward by means of the operating lever to the position shown by dotted lines. A patent on this improved fruit picker has recently been granted to Mr. Emil Gier, Mount Angel, Ore.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

SHIRT-WAIST AND SKIRT ADJUSTER.—L. Barnett, Milliville, N. J. The object of this inventor is to provide an improved shirt waist and skirt adjuster, arranged for convenient attachment to the waist and skirt, to allow of readily connecting and disconnecting the same at the back, to hold the skirt up and the shirt waist down, and to keep the slit of the skirt securely closed.

Electrical Devices.

THERMOSTAT.—J. M. Harrison, New York, N. Y.—The more particular object in this case is to produce a type of thermostat of general service in the various arts, and adapted to produce considerable variations in heavy currents, and yet being peculiarly sensitive in heat. The special object, in other words, is to enable comparatively trivial variations in heat to produce great variations in the flow of a heavy current.

SIGNAL.—C. R. Dowler, Denver, Col. The invention consists of means on the semaphore device, adapted for holding it at safety display, circuit "closers" operated by floats or other automatic means, suitable circuit wiring with any source of electric current supply, and automatic means whereby to adjust the semaphore to danger display. The invention relates to railway signals.

Of General Interest.

FIRE-HOSE HOLDER.—J. Kenlon, New York, N. Y. The object in this improvement is to produce a holder which may be quickly set in position, and which will operate to hold a fire hose near the nozzle in such a way as to support the back pressure and enable the nozzle to be adjusted to give the stream any direction.

SURGICAL OR MEDICAL BANDAGE.—P. F. W. Kappmeier, 173 Staderstrasse, Alt Kloster, Germany. In this patent the inventor has for his object a wet compress adapted to be heated and more particularly intended for the treatment of sea sickness. In view of compresses and bandeges of other kinds, it is essential that with this new compress surface heating and surface compression coöperate one with the other. Applied as hot and as firmly as bearable, it reduces to normal the circulation of blood between the head and stomach.

NON-REFILLABLE BOTTLE.—O. Johnson, Beatty, Nevada. In the operation of this improvement it will be found that when the stopper is applied, it cannot be withdrawn without breaking the bottle and the contents of the bottle can be freely dispensed, a valve opening to permit the outlet of the liquid and the air in the bottle through a venting tube when the cap is removed.

DISPLAY-COVER.—G. E. H. Richter, Chattanooga, Tenn. The improvement is in display covers for use on tubs or pails containing candy, fruit, etc. The cover is applied to a tub and secured by screws, which latter permit the application of the cover to tubs of different sizes. The cover comprises a base ring adapted to rest on the top of the tub and provided at its inner edge with depending lugs having threaded openings for the screws so the devices for securing the cover on the tub will be entirely within the latter and not exposed.

GUTTER-INSERTER.—D. A. Sapp, Towns, Ga. The device in this invention is a very effective substitute for the ordinary hammer commonly used in inserting gutters according to the old method. Such insertion is a work of considerable difficulty, and the inventor has devised a tool by which it can be effected easily, quickly, and accurately, and also without any danger of injury to the hands of the workmen in operation.

MINER'S PAN.—P. A. Hardwick, Colorado City, Col. The invention relates to improvements in hand-operated pans for separating gold or like values from sand, gravel, etc., the object being to provide a pan so constructed that with its use a much greater percentage of values may be saved than is possible with the usual pan, in which a considerable amount of fine gold is washed over the edges of the pan with the sand and gravel, especially by an inexperienced person.

FIRE-ESCAPE.—S. P. Deeds, Circleville, Ohio. A purpose in this invention is to provide a portable fire escape that can be readily carried in a hand bag and secured to any convenient support or article of furniture or which may be a fixture in a building, in which event the device is placed convenient to the window or other opening.

Machines and Mechanical Devices.

WHEEL-SCRAPER.—C. W. Goodsman, St. Johns, Ore. This improvement refers to scrapers mounted on carrier wheels and has for an object to provide a device adapted to be readily controlled in its movements. In operation the scoop is readily unloaded, and by releasing the draft from the free ends of the fulcrum levers and applying it to the cable, the former may be again brought over onto the back of the scoop, thereby raising the carrying wheel from the ground and supporting the scoop on the scraping blade, when the former scraping operation is repeated.

HOISTING AND CONVEYING APPARATUS.—G. A. Fox and D. Davidson, Tustin, Mich. The apparatus is particularly useful in logging operations. An object of the invention is to provide an apparatus by means of which heavy objects may be moved from place to place without danger of accidentally releasing the same from the holding device. It provides a device in which a slack rope carriage is used to pay out or take up the necessary slack in the fall rope required for transporting objects.

Prime Movers and Their Accessories.

INTERNAL-COMBUSTION ENGINE.—H. G. Wood, Newport, R. I. The prime object here is to improve a means for scavenging the cylinder of an internal-combustion engine. A scavenging piston operates so as to clear out the product of combustion from the cylinder, and avoids using the power piston at times as a pump for forcing out the burned gases. The apparatus also involves means for introducing the fuel charge into the cylinder, and further means for cooling the scavenger piston by circulation of cooling fluid therein. Claims for the last named means are not incorporated in this application.

Railways and Their Accessories.

SWITCH.—B. L. Murphy, Colorado Springs, Col. The object in this case is to provide a switch at which the main line track is continuous and unbroken, which can be operated manually at the switch itself, and which can be operated from a moving train approaching the switch from either direction. By means of this switch a train in passing from the main track to the branch track rides upon elevated rails and passes over the rails of the main line track without coming in contact with the same.

MINE-CAR.—T. M. Edmondson, Los Angeles, Cal. The main object in this invention is to provide means whereby a mine car may be loaded with the least expenditure of time and labor. It frequently becomes necessary to remove the drill machinery and column out of a mine. This cannot be done conveniently with the ordinary box car now in use, and one of the objects is to provide a car capable of quick and ready loading, and adapted to receive and transport mining appliances out of the car.

Pertaining to Recreation.

ROLLER-SKATE.—B. Domis, Covington, Ky. Each skate is provided with two wheels with axles disposed in parallel planes at right angles to the center line of the shoe rest or plate, but with axle bearings disposed obliquely to each other, so that the skater moves the center of gravity of his body over the skates, which enables him to preserve equilibrium and cut figures with easy body movements, and not done with roller skates now used. The skate has fewer running parts than others, which lessens friction and the skater's exertion.

Pertaining to Vehicles.

BRAKE MECHANISM.—W. H. Douglas, Belleville, N. J. The improvement relates to brakes having a brake wheel and a flexible band for engagement with the rim of the brake wheel. The object is to provide a brake mechanism for use on automobiles and other machines and arrange to permit the operator to conveniently and forcibly apply the mechanism when desired, and to instantly release the brake mechanism when required.

DRIVING-GEAR FOR MOTOR-VEHICLES.—W. H. Douglas, Belleville, N. J. This invention relates to driving gears in which the steering wheels are positively driven, as shown and described in the Letters Patent of the United States, formerly granted to Mr. Douglas. The object is to provide improvements in driving gears for motor vehicles, whereby power is transmitted without undue loss and a proper lubrication of the parts is had to insure an easy running thereof.

FLEXIBLE SHAFT.—W. H. Douglas, Belleville, N. J. In the present patent the invention has for its object the provision of a flexible shaft which is simple and durable in construction and arranged to readily flex in any desired direction without undue binding or straining of the parts or loss of the power to be transmitted.

CONTROLLER FOR DRIVING-GEARS.—W. H. Douglas, Belleville, N. J. The invention relates to automobiles and other motor vehicles, and its object is to provide a controlling device for the driving-gear of motor vehicles, arranged to enable the operator to change speed gradually when running forward or backward, and to compel the operator to reduce the speed to zero before being able to reverse the driving-gear.

WHEEL.—W. H. Douglas, Belleville, N. J. The improvement has reference to the traction wheels of motor cars and other vehicles, and its object is to provide a new and improved wheel having a readily detached rim, to permit an exceedingly quick removal of the rim and tire in case of accident, and replacing by a rim and tire constructed and arranged for immediate use.

Note.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

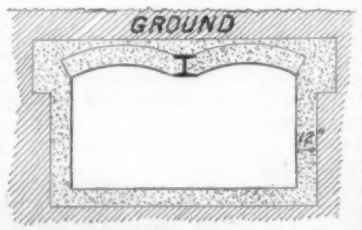
Notes and Queries.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.
Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.
Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.
Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(10617) I. J. S. asks: Which will require the more energy—to raise 100 gallons of water to the height of 46 feet, or to fill the 100 gallons space with compressed air to the consistency of 40 pounds pressure? Suppose the 100 gallons space to be at 20 pounds pressure, then you want 20 pounds more in said space, will it require more energy to get the air to the 40-pound mark, starting at 20-pound mark, than it would to raise water 46 feet? If so, what per cent difference would there be, and which is the less labor? A. Theoretically, it would require 38,333.18 foot pounds of energy to raise 100 gallons of water to a height of 46 feet. In order to compare this with the amount of energy required to compress the same volume of air to 46 pounds per square inch, and from 20 pounds per square inch to 40 pounds per square inch, it will be necessary to assume that the 100 gallons water is raised 46 feet every minute and that the air is compressed to the pressures stated every minute. It will then be possible to reduce the energy required to horse-power and in this way arrive at a comparison. 38,333.18 foot pounds per minute is equivalent to 1.16 horse-power. It will require 1.38 horse-power to compress enough free air to occupy 13.36 cubic feet at 40 pounds gage pressure every minute, and just one-half that amount to compress enough free air to change the pressure in a space of 13.36 cubic feet from 20 pounds gage pressure to 40 pounds gage pressure every minute. From these figures you will see that to raise 100 gallons of water 46 feet per minute requires 1.16 horse-power; to compress air to fill the 100-gallon space or 13.36 cubic feet at 40 pounds gage pressure per minute requires 1.38 horse-power; to compress air to change the pressure in the 100-gallon space (from 20 pounds gage pressure) to 40 pounds gage pressure would require 0.69 horse-power. These amounts do not allow for losses in operation, but you can safely assume these losses at about 15 per cent in each case.

(10618) C. E. H. says: We are interested in the automobile business, and use gasoline in large quantities, and we are somewhat embarrassed in the matter of storing it in bulk with a minimum of risk. We are making considerable addition and enlargement in our place, and the thought has occurred to us that if it were possible to build under ground away from our building a concrete storage tank holding anywhere from 50 to 75 barrels of gasoline, it would help us out of the embarrassing situation very much. We were uncertain however whether concrete was a suitable medium in which to store gasoline. I am aware of the fact that it is somewhat porous, but I thought it probable that you could suggest some coating by which its porosity could be overcome, so that it might be



made absolutely tight. We much prefer to use concrete instead of an iron tank if such a thing is possible. The former being practically indestructible and everlasting, while the latter would be much more expensive, and being buried in the soil, we fear it would have a comparatively short lifetime. A. A concrete tank such as you describe is entirely practical, and could be made leak-proof in the following manner: After the bottom and sides of the tank are constructed, and the concrete *thoroughly* dried, saturate every part of the concrete with hot paraffin wax, heating small portions of the wall at a time with a blowpipe before the hot wax is applied. Hot irons can be used to press in the wax as soon as it begins to lie on the surface of the concrete. After every part of the concrete is thoroughly saturated with the wax, and completely cooled, the cover may be put on. This must be saturated with wax from the top or outside, but as the wax works its way through the concrete, it will stop up all of the pores of the concrete, and form a leak-proof tank.

NEW BOOKS, ETC.

The Elements of Mechanics. A Textbook for Colleges and Technical Schools. By W. S. Franklin and Barry Macnutt. New York: The Macmillan Company. 8vo.; cloth; 283 pages. Price, $1.50.

So many works on mechanics have been written that a new book on the subject must have great originality of treatment or facility of explanation to rise above the level already established. "The Elements of Mechanics" is rather below this level than above it. Certain simple concepts are explained at length, while other more complex ideas are merely hinted at. In the main, the analogies, drawn from common-place happenings, are not sufficiently marked to be of assistance in driving home the points they are intended to make clear. The result is a work that is too childish for colleges and too difficult for less advanced students.

American Breeders' Association. Vol. I., 1905. Washington, D. C.: W. M. Hays, American Breeders' Association. 8vo.; cloth; 243 pages.

The plant and animal products of the United States help swell our national prosperity to an enormous extent, and every addition to the knowledge of their production increases the permanent wealth of the country, for agriculture and breeding can be carried on indefinitely, if only the rules of science are observed. The American Breeders' Association, founded for the furthering of this knowledge, has recently published its proceedings in two volumes. They are interesting and important. Such an association should receive universal support, for the entire country benefits by its findings.

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